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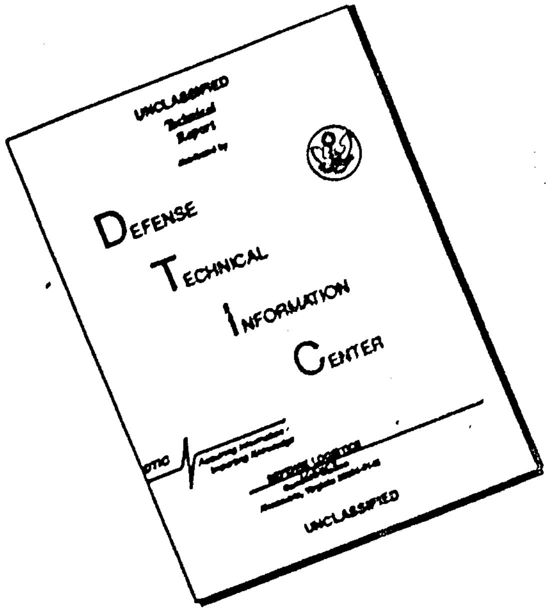

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NAVY DEPARTMENT

THE DAVID W. TAYLOR MODEL BASIN

Washington 7, D. C.

TESTS OF TWENTY RELATED MODELS OF V-BOTTOM MOTOR BOATS

EMB SERIES 50

MARCH 1949 Revised Edition REPORT R-47

Tests of Twenty Related Models
of
V-Bottom Motor Boats

E.M.B. SERIES 50

for

The David Taylor Model Basin

REPORT NO. 170

by

Kenneth S. M. Davidson
and
Anthony Suarez

October 28, 1941
Revised December 1948

EXPERIMENTAL TOWING TANK
Stevens Institute of Technology
Hoboken, New Jersey

FOREWORD

This report is a revision of a former report, bearing the same title and number, published by the David Taylor Model Basin in October 1941. The original report was compiled by the Stevens Institute of Technology and dealt with a series of tests conducted in the Stevens Experimental Towing Tank at the request of Taylor Model Basin. The revision, based on subsequent work done at Stevens, consisted principally in the addition of charts showing running trim and a drawing of the parent form, together with conversion factors for the other models. The original text has also been modified slightly to include suitable references to the new data.

C O N T E N T S

INTRODUCTION

This report presents the principal results of an investigation of the effects on the performance of V-bottom boats of variations in proportions and loading, in a form for ready use by designers. Tabulations of the complete test data are on file for reference at the Experimental Towing Tank, Stevens Institute of Technology, Hoboken, New Jersey, and at the David W. Taylor Model Basin, Carderock, Maryland.

Tests were made of a series of twenty models derived from a single parent form. The models were designed at the United States Experimental Model Basin, Washington, D. C., and are designated U.S.E.M.B. Series 50.

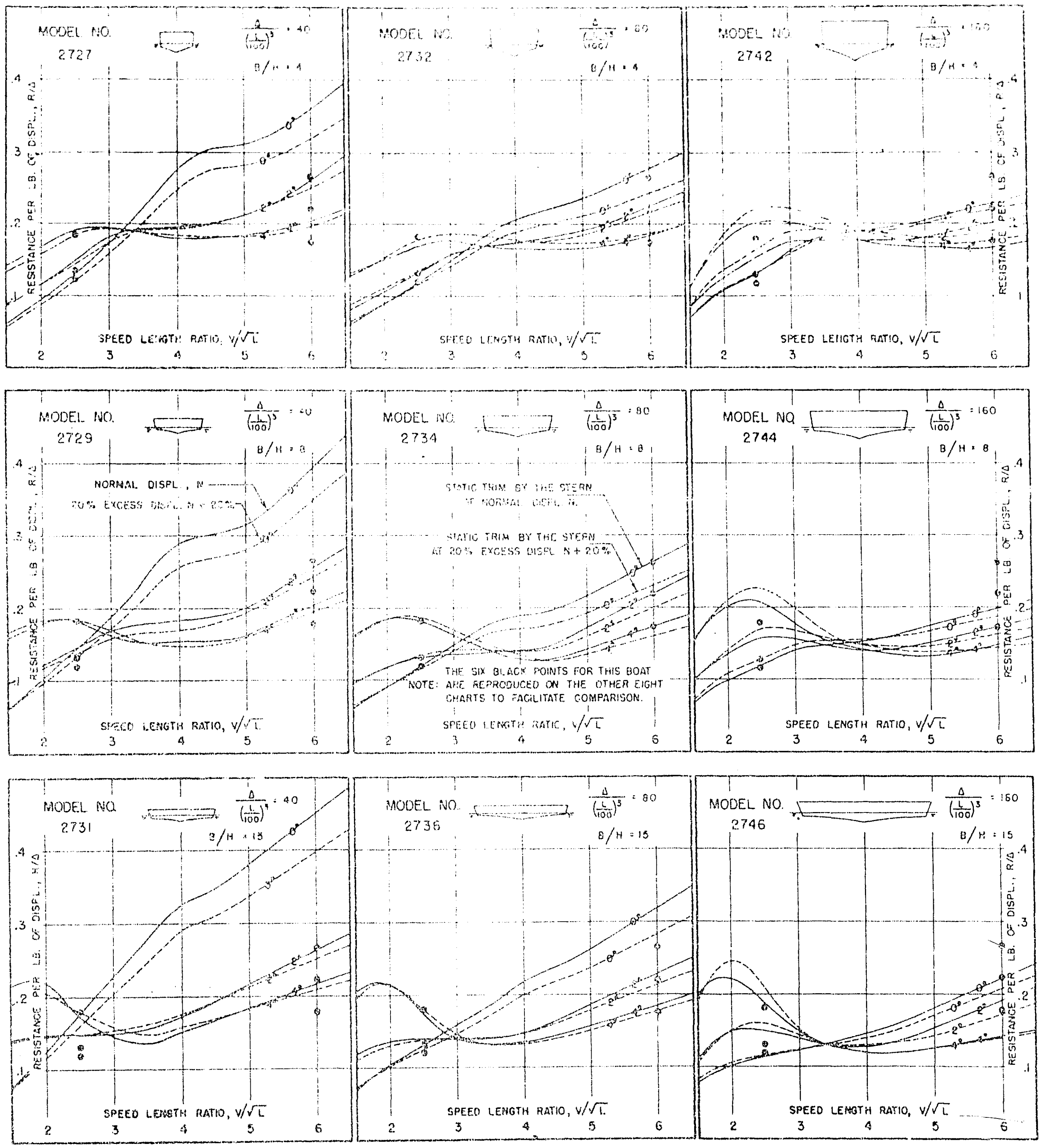
The models were 40 inches in length and had:

displacement-length ratios, $\Delta / \left(\frac{L}{100}\right)^3$	40, 80, 120, 160
beam-draft ratios, B/H	4, 6, 8, 11, 15

Page 8 gives the dimensions and particulars of the twenty models together with the multipliers used to obtain the offsets of the series models from the parent model. The lines and offsets of the parent design, $\left[\Delta / \left(\frac{L}{100}\right)^3 = 110;\ B/H = 5.3\right]$, are shown on page 9. A photograph of the twenty models is included, page 11.

The tow point for all models was 1/2 inch above the designed L.W.L. and at the midlength.

The investigation was made for the David W. Taylor Model Basin, Carderock, Maryland, under United States Navy Contracts Nos. N171s-50126 and N171s-54701.



$\frac{R_{TOTAL}}{\Delta}$ VS. $\frac{V}{\sqrt{L}}$ FOR THE CENTRAL AND THE EIGHT EXTREME MODELS OF THE SERIES
SIX LOADING CONDITIONS ARE SHOWN FOR EACH MODEL

Resistances

The chart on page 2 provides a comprehensive overall view of the resistances. This chart brings out clearly:

1) the major importance of static trim,
2) the pronounced importance of displacement-length ratio,
3) the relatively lesser importance of both beam-draft ratio and excess displacement.

The contour charts on pages 13-45, incl., define the resistances in detail. These charts provide a broad system of resistance data for V-bottom forms, comparable in general to that provided for steamship forms by the contour charts for Taylor's Standard Series in THE SPEED AND POWER OF SHIPS.

There are three sets of contour charts:

for normal displacement, N		pages 13-23
for 10% excess displacement, N + 10%		pages 24-34
for 20% excess displacement, N + 20%		pages 35-45

The three charts on each page are for three values of static trim by the stern, τ, at constant speed-length ratio, $V/\sqrt{L}$.

It will be seen that, in laying out the Series 50 models, the procedure for systematically varying the model proportions followed the precedent established by Taylor's Standard Series of steamship forms in that variations were made in displacement-length ratio and beam-draft ratio, both factors being based upon the designed L.W.L. of the parent form. This procedure, with the logical extension of the test program to include given angular changes of static trim, fixed the form of presentation for the resistance contour charts.

In the actual design of a V-bottom boat, however, the factors most readily fixed in the early stages will usually be:

a) Length	L,
b) Displacement	Δ,
c) Longitudinal Center of Gravity	L.C.G.,
d) Beam	B;

a) and b) emerging first, followed by c) when a preliminary weight distribution has been worked out, and then by d). These factors fix:

$$\Delta\Big/\left(\frac{L}{100}\right)^3, \text{ L.C.G.}/L, \text{ and } B/L;$$

but they do not fix:

$$B/H \text{ or } \tau$$

both of which necessarily appear as parameters on the resistance contour charts. Hence, to make a preliminary estimate of power required, on the basis of the Series 50 resistance contours, it will usually be necessary, first, to transform

given values of B/L and L.C.G./L into the equivalent values of B/H and τ for the Series 50 form.

The same problem may often arise in selecting the Series 50 form which corresponds to a given finished design, for the purpose of comparing the power requirements. For V-bottom forms in general, neither B/H nor τ has the simple, straightforward significance either has for steamship forms; H depends upon the amount and longitudinal variation of the deadrise, and τ upon the transom beam and the up-sweep of the buttocks aft. It will usually be desirable, then, to define correspondence between the two forms in terms of the same basic factors, a), b), c), d), listed in the previous paragraph.

The following notes relate to the transformation of B/L to B/H, and of L.C.G./L to τ, for Series 50 forms.

B/L to B/H

Writing Volume = $K_1 \times B \times H \times L$, where K_1 is the block coefficient for the Series 50 form = 0.407

and $H = \frac{B}{B/H}$

then Volume = $K_1 \frac{B^2}{B/H} L$

or $B/H = \frac{K_1 B^2 L}{\text{Volume}}$

dividing the righthand side by L^3/L^3

$$B/H = K_1 \frac{(B/L)^2}{\text{Volume}/L^3}$$

or $B/H = K_2 \frac{(B/L)^2}{\Delta/\left(\frac{L}{100}\right)^3}$, where $K_2 = 1.16 \times 10^4$.

This formula contains the necessary factors for the transformation.

L.C.G./L to τ

The static trim can be obtained by interpolation from the contour charts of L.C.G. described in the next section. Although an equation could be worked out for this relationship, it would be much less simple to use than the contour charts.

Example of E.H.P. Estimate. Suppose it is desired to find the E.H.P. of a Series 50 form having the following particulars (or of the Series 50 form corresponding to a given form having the same particulars), at the indicated speed:

V = 35 knots

L	60.00 feet
Δ (sea water)	23.75 tons, designed 26.13 tons, actual (10% excess)
L.C.G.	64% of L from F.P.
B	13.45 feet

(1) $\Delta/\left(\frac{L}{100}\right)^3 = \frac{[illegible]}{(60/100)^3} = 110$

(2) $B/L = \frac{13.45}{60.00} = 0.224$

(3) $V/\sqrt{L} = \frac{35}{\sqrt{60.00}} = 4.5$

(4) From the formula, $B/H = \frac{1.16 \times 10^4\ (0.224)^2}{110} = 5.3$

(5) From the L.C.G. contour chart on page 82,

when $\tau = 0^\circ$ (level trim), L.C.G. = 56.5%

when $\tau = 2^\circ$ (by the stern), L.C.G. = 65.3%

interpolating, $\tau = \frac{64.0 - 56.5}{65.3 - 56.5} \times 2^\circ = 1.7^\circ$ (for L.C.G. = 64%)

(6) Entering the resistance contour charts on page 30 (for $V/\sqrt{L} = 4.5$) with the above values of $\Delta/\left(\frac{L}{100}\right)^3$, and b/H,

when $\tau = 0^\circ$, $R/\Delta = 0.185$ pounds per pound of displacement,

when $\tau = 2^\circ$, $R/\Delta = 0.168$ " " " " "

Interpolating for $\tau = 1.7^\circ$

$0.185 - \frac{1.7}{2.0}(0.185 - 0.168) = 0.185 - 0.014 = 0.171$ lbs./lb.

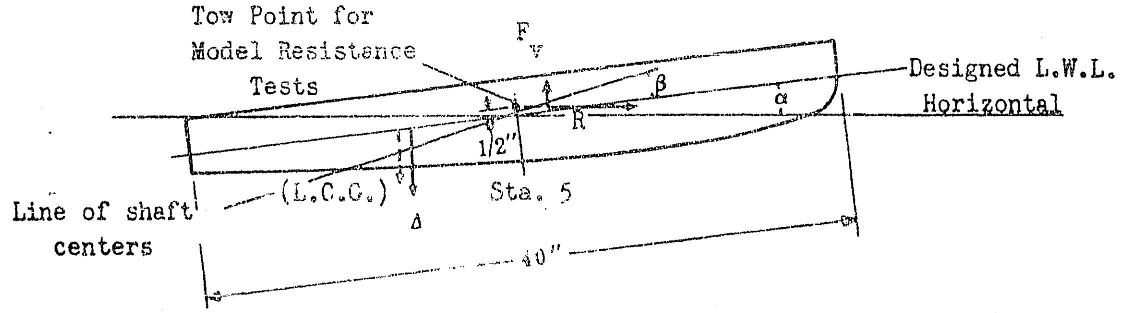
(7) Then,

E.H.P. $= 0.003071 \times \frac{R}{\Delta\text{(lbs.)}} \times \Delta\text{lbs.} \times V$

E.H.P. $= 0.003071 \times (0.171 \times 26.13 \times 2240) \times 35 = 1076$

<u>Shaft Angle and Position.</u> The necessary data for taking into consideration the effect of any prescribed shaft line are available in the test results. The contours of running trim angle on pages 47-79 are necessary for this purpose.

L.C.G., R/Δ, will be known, and the trim angle α,* can be obtained by adding the static trim to the running trim obtained from the contours. Let β be the shaft angle. The vector diagram shown below will then illustrate the disposition of the forces, where F_v is the vertical component of the thrust, which was not present in the model tests. From inspection, it is seen that



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* $\alpha = \tau + \Delta\tau$ (static trim + running trim).

F_n = k tan [illegible]. The effect of this force is both to decrease the displacement and to shift the L.C.G. aft to (L.C.G.)'.* Convert the new displacement to a per cent of the normal displacement (23.75 tons in the example given in the previous paragraph). Determine, by interpolation from the L.C.G. contour charts, a new static trim angle τ' corresponding to the new (L.C.G.)' at the new percentage of normal displacement. A new value of resistance, corresponding to the changed conditions, can now be found by the procedure in (6) on page 5. A second approximation can be made if necessary.

Contours of Running Trim

The contour charts on pages 47-79 give running trims for the whole series. Running trim is defined as the change of trim, ($\Delta\tau$), due to the forward motion of the model.

Again, there are three sets of contour charts:

for normal displacement, N	pages 47-57
for 10% excess displacement, N + 10%	pages 58-68
for 20% excess displacement, N + 20%	pages 69-79

As for the resistance contours, there are three charts on each page for three values of static trim by the stern.

Longitudinal Centers of Gravity

The contour charts on pages 81-83 define the relationship between the static trim by the stern, τ, and the position of the longitudinal center of gravity, L.C.G., for all of the models of the series. The purpose of these charts is explained in the preceding section, page 4.

There are three sets of contour charts:

for normal displacement, N	page 81
for 10% excess displacement, N + 10%	page 82
for 20% excess displacement, N + 20%	page 83

Wetted Surfaces

The contour charts on pages 85-94 define the wetted surfaces. These charts are included to permit making expansions to full size by treating the friction and residual components independently (as is usual for displacement-type vessels), if this is desired. They are necessary, in the case of V-bottom forms, because of the large variation of the wetted surface with speed.

There are two sets of contour charts:

for normal displacement, N	pages 85-89
for 20% excess displacement, N + 20%	pages 90-94

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* (L.C.G.)' is the position of the resultant of Δ and F_n.

Once the wetted surface is determined, the expansion to full size can be carried out by the usual procedures employed for large ships, except that a friction formulation which provides satisfactory turbulent friction data for 40-inch models, such as the Schoenherr, must necessarily be adopted.

Porpoising.

It was found in the course of the resistance tests that, in many instances, a longitudinal instability developed with increase of speed, similar in character to that ordinarily described in connection with seaplanes as porpoising. Damped out for the resistance tests, this condition was subsequently studied more carefully in a separate series of tests on seven selected models of the series.

The results of these tests are summarized in the charts on page 96, which indicate limiting speed-length ratios for longitudinal stability. They are shown in detail in the graphical records of the porpoising motion of each model tested, on pages 97-103.

There is no evidence that these porpoising tests for Series 50 forms necessarily describe the porpoising characteristics of other forms of different shapes. It is believed, however, that they are reasonably indicative for most forms.

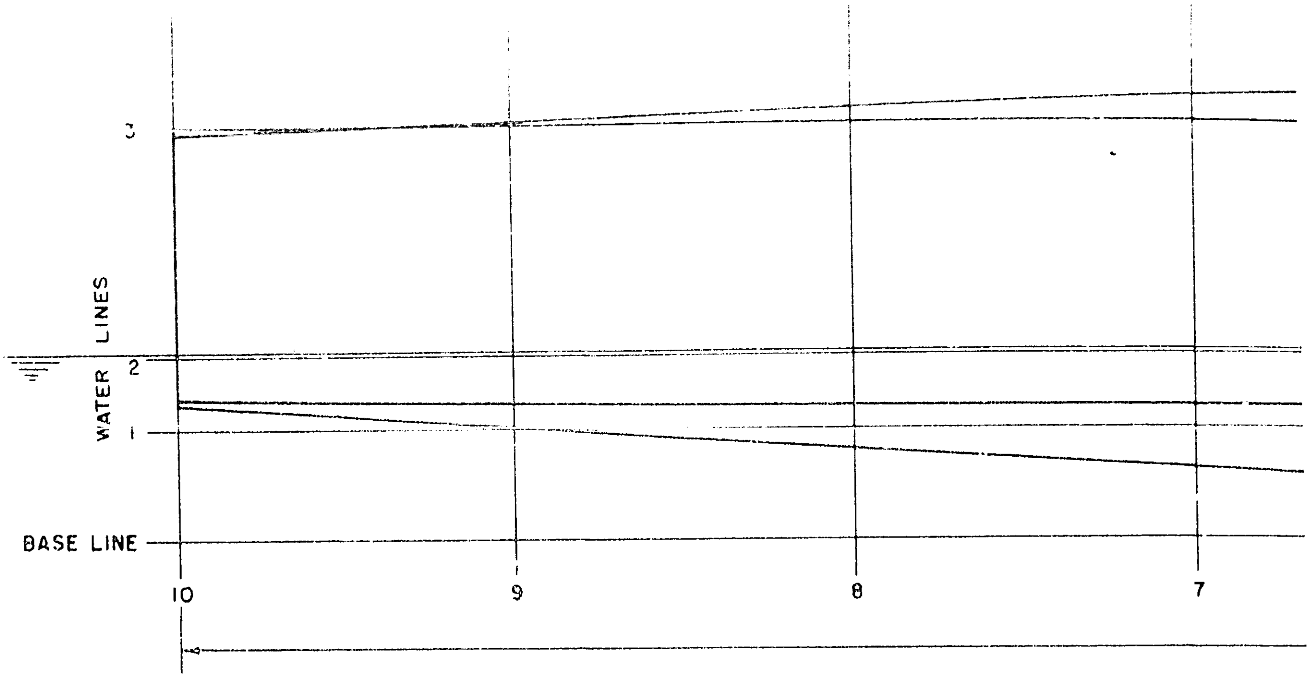
PARTICULARS AND DIMENSIONS

$\Delta/\left(\frac{L}{100}\right)^3$	Displacement pounds	B/H	4		8	11	15
40	3.24	Model Beam Draft	2727 4.760 1.190	2728 5.827 0.97	2729 6.725 0.841	2730 7.890 0.717	2731 9.215 0.614
80	6.48	Model Beam Draft	2732 6.730 1.682	2733 8.240 1.373	2734 9.518 1.190	2735 11.160 1.014	2736 13.040 0.869
120	9.73	Model Beam Draft	2737 8.240 2.060	2738 10.100 1.683	2739 11.650 1.457	2740 13.660 1.242	2741 15.960 1.064
160	12.97	Model Beam Draft	2742 9.515 2.379	2743 11.660 1.943	2744 13.460 1.683	2745 15.780 1.435	2746 18.440 1.229

Values of beam and draft in inches.
Beam of LWL, and draft to the rabbet.
Model Length, 40 inches.

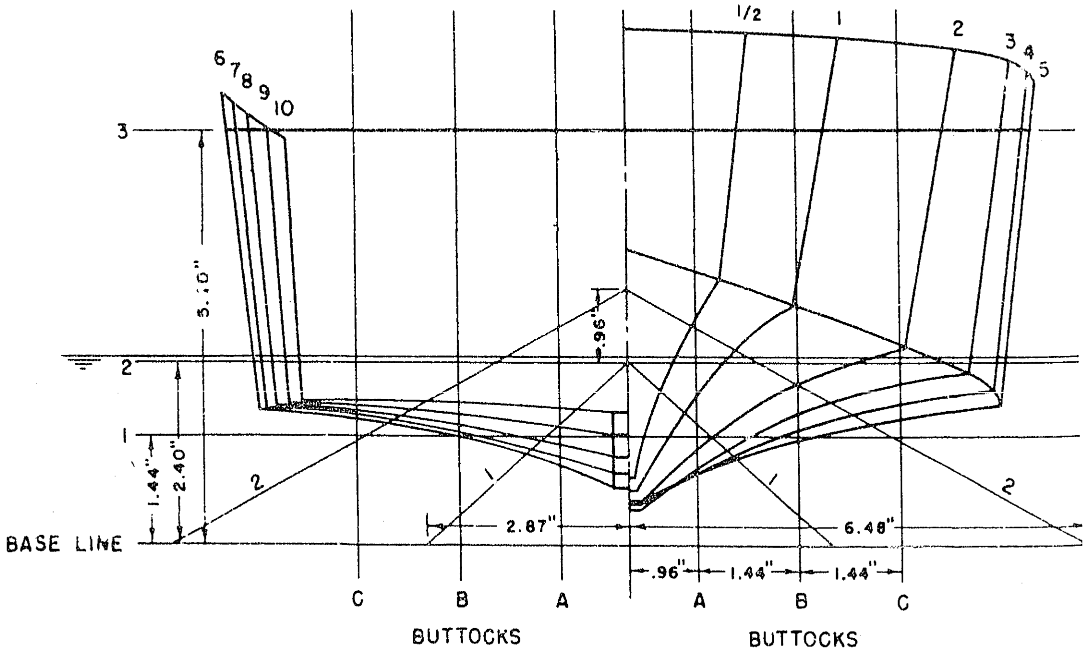
ENLARGEMENTS FROM PARENT MODEL

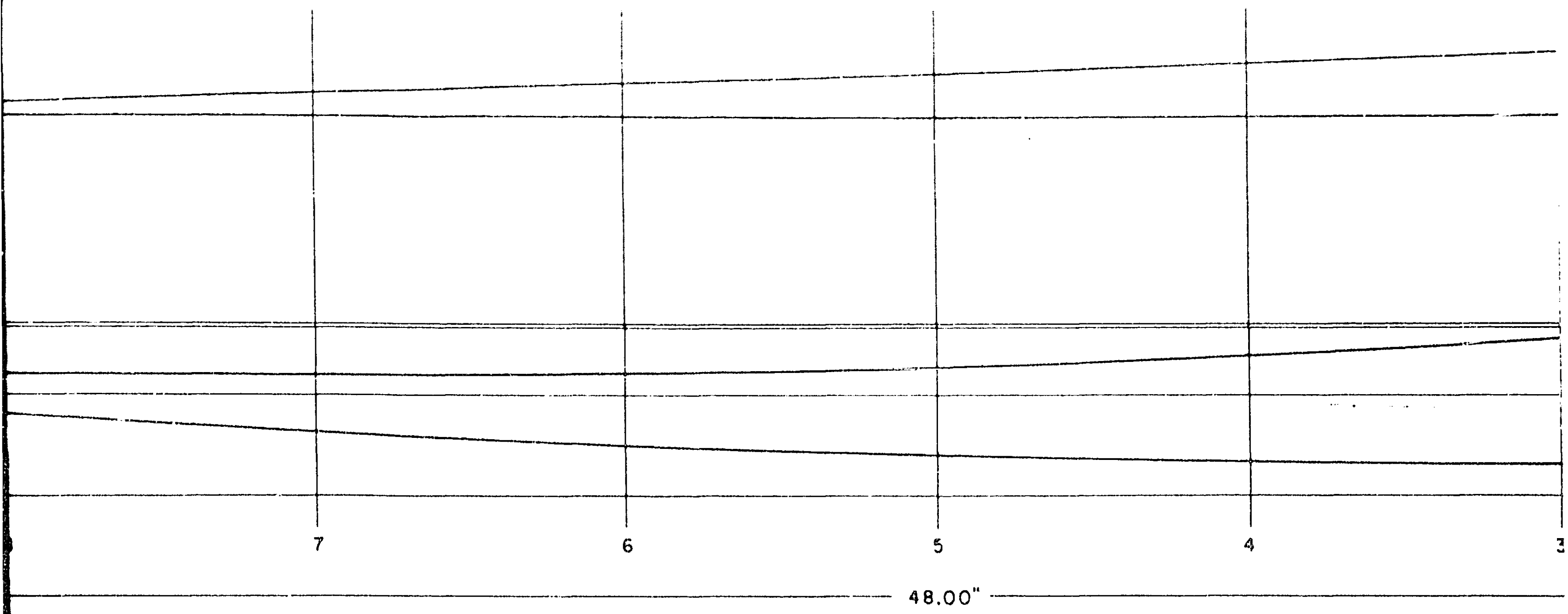
Model	Enlargement		Model	Enlargement	
	Beam	Draft		Beam	Draft
2727	0.4444	0.5765	2737	0.7694	0.9989
2728	0.5441	0.4705	2738	0.9431	0.8160
2729	0.6280	0.4075	2739	1.0880	0.7063
2730	0.7365	0.3475	2740	1.2760	0.6022
2731	0.8600	0.2976	2741	1.4900	0.5158
2732	0.6282	0.8160	2742	0.8884	1.1535
2733	0.7695	0.6655	2743	1.0884	0.9420
2734	0.8887	0.5770	2744	1.2570	0.8159
2735	1.0420	0.4916	2745	1.4740	0.6958
2736	1.2177	0.4213	2746	1.7220	0.5958



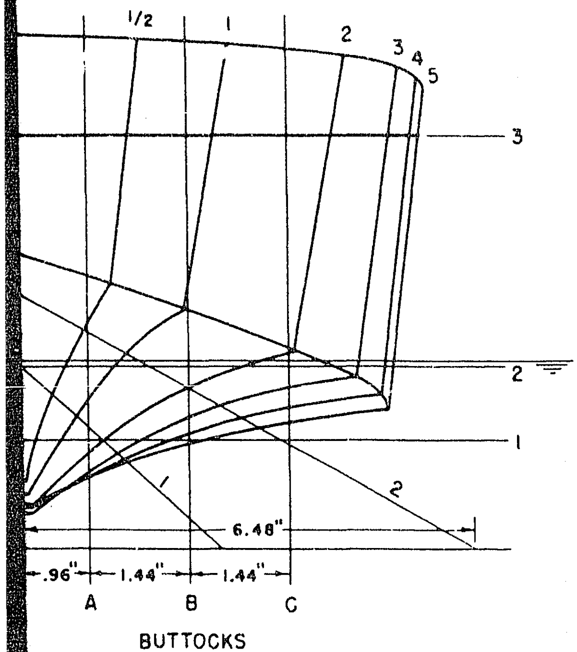
NOTE: DESIGNED L.W.L. CORRESPONDS TO STATIC TRIM BY THE STERN, $\tau = 0°$

1





THE STERN, γ = 0°



2

TABLE OF

STATION		HALF-BREADTHS							DIAGO
		KEEL	WATER-LINES			CHINE	DECK		
			1	2	3				1
1/2		0.15	0.24	0.63	1.55	1.285	1.72		0.595
1		0.175	0.57	1.36	2.77	2.34	2.99		1.015
2		0.195	1.23	3.22	4.44	3.915	4.64		1.54
3		0.22	1.77	4.83	5.28	4.80	5.415		1.80
4		0.23	2.21	5.225	5.59	5.175	5.685		1.93
5		0.235	2.54	5.345	5.71	5.28	5.78		1.98
6		0.24	2.61	—	5.67	5.24	5.73		1.95
7		0.24	2.32	—	5.54	5.13	5.57		1.81
8		0.24	1.68	—	5.34	4.995	5.35		1.61
9		0.24	0.24	—	5.08	4.82	5.075		1.325
10		0.24	—	—	4.81	4.63	4.81		0.985

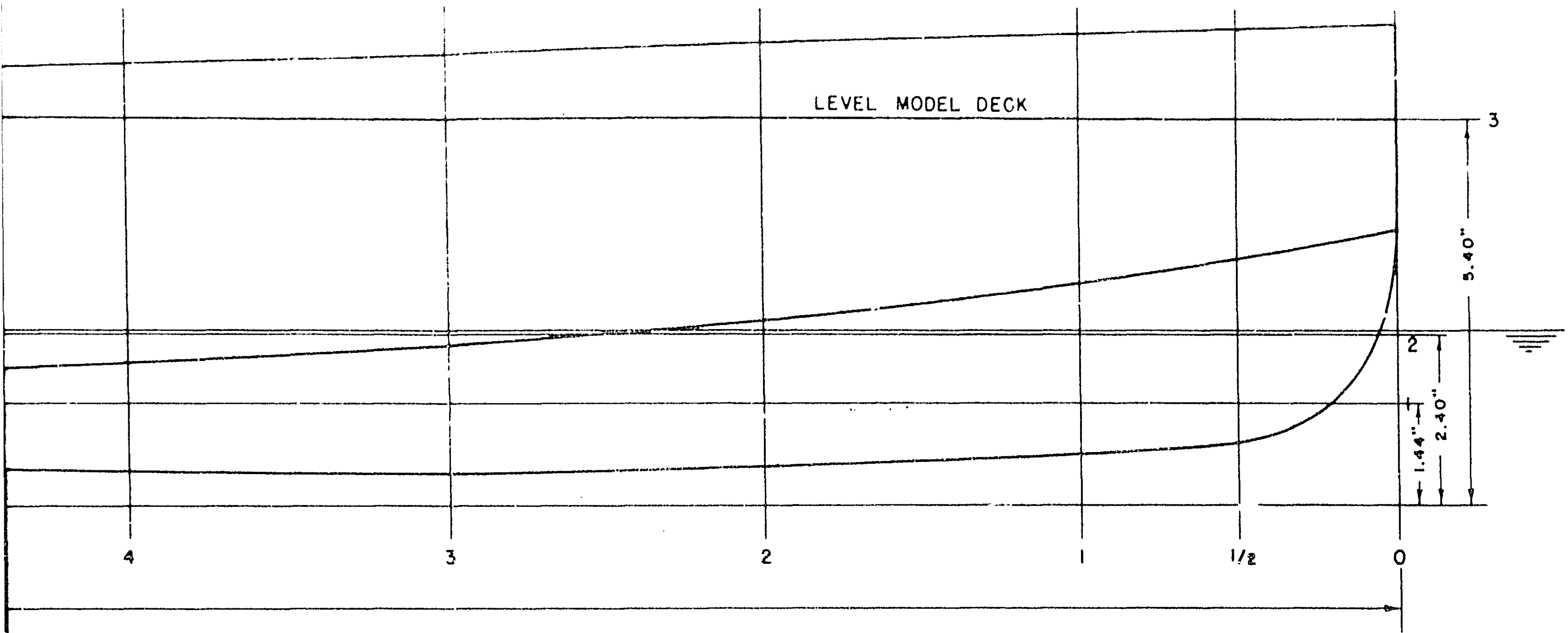
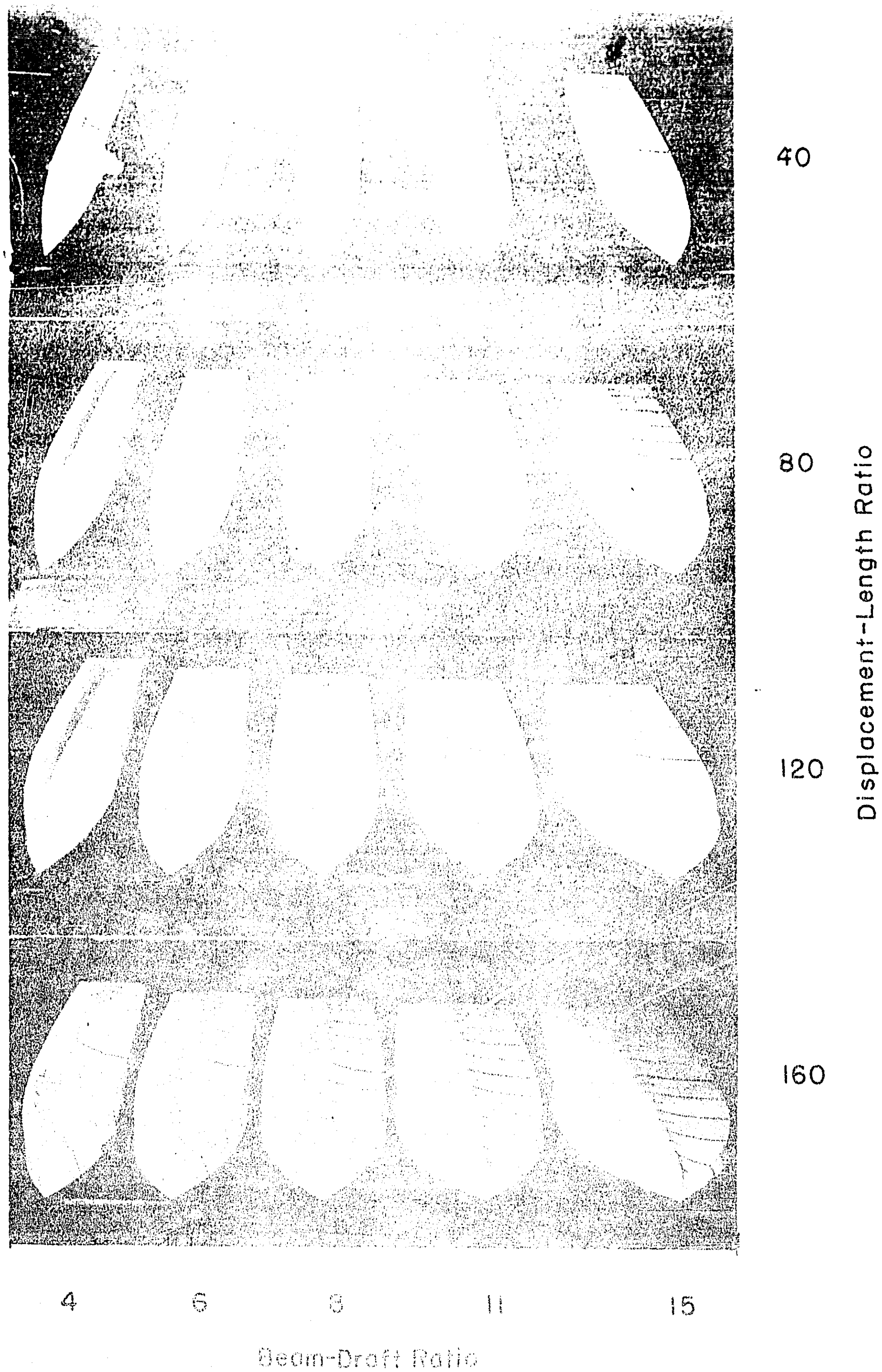


TABLE OF OFFSETS

-BREADTHS					DIAGONALS			HEIGHTS							STATION
LINES		CHINE	DECK		1	2		KEEL	BUTTOCKS			CHINE	DECK		
	3								A	B	C				
	1.55	1.285	1.72		0.595	1.01		0.89	2.99	——	——	3.46	6.65		1/2
	2.77	2.34	2.99		1.015	1.73		0.71	1.98	——	——	3.14	6.58		1
	4.44	3.915	4.64		1.54	2.70		0.53	1.23	2.12	2.57	2.58	6.43		2
	5.28	4.80	5.415		1.80	3.235		0.46	0.985	1.705	2.095	2.22	6.29		3
5	5.59	5.175	5.685		1.93	3.575		0.485	0.92	1.50	1.835	1.99	6.14		4
5	5.71	5.28	5.78		1.98	3.77		0.57	0.90	1.405	1.70	1.83	6.00		5
—	5.67	5.24	5.73		1.95	3.84		0.73	0.975	1.39	1.645	1.765	5.86		6
—	5.54	5.13	5.57		1.81	3.785		0.94	1.125	1.46	1.665	1.745	5.71		7
—	5.34	4.995	5.35		1.61	3.70		1.17	1.310	1.55	1.705	1.765	5.57		8
—	5.08	4.82	5.075		1.325	3.525		1.44	1.535	1.68	1.775	1.81	5.42		9
—	4.81	4.63	4.81		0.985	3.28		1.73	1.775	1.835	1.865	1.865	5.28		10

3


40
80
120
160
Displacement-Length Ratio
4
6
8
11
15
Beam-Draft Ratio

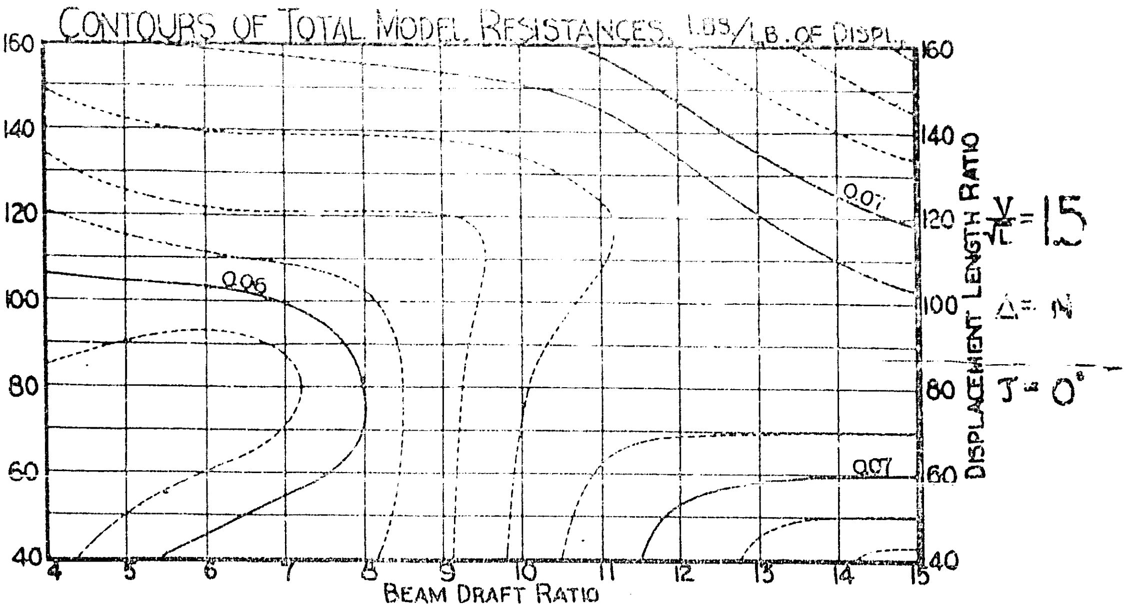
CONTOURS

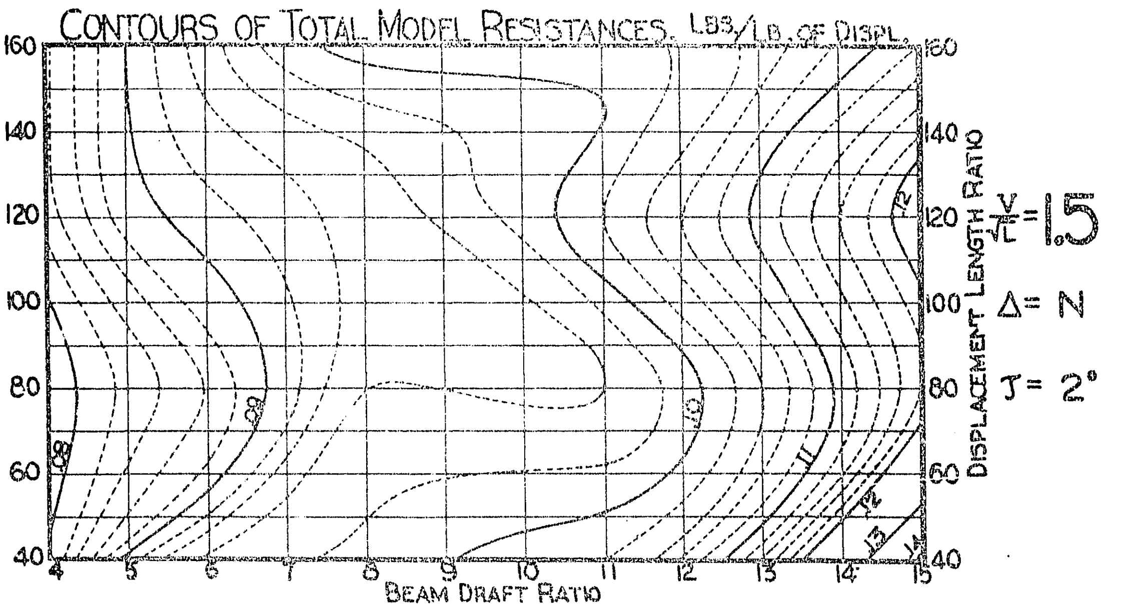
OF

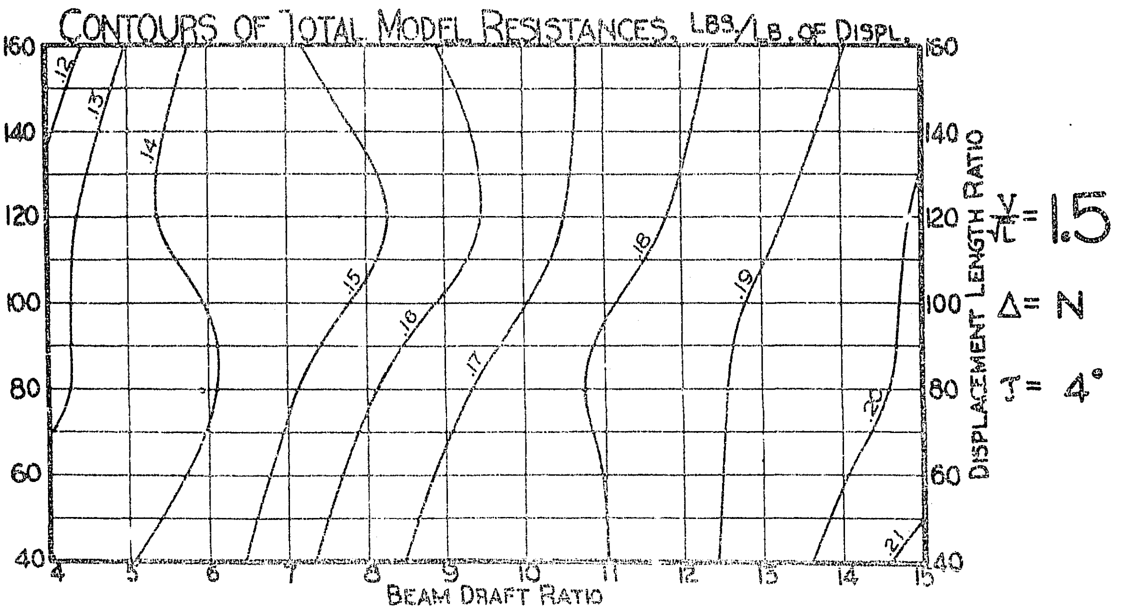
RESISTANCE

PER POUND OF DISPLACEMENT

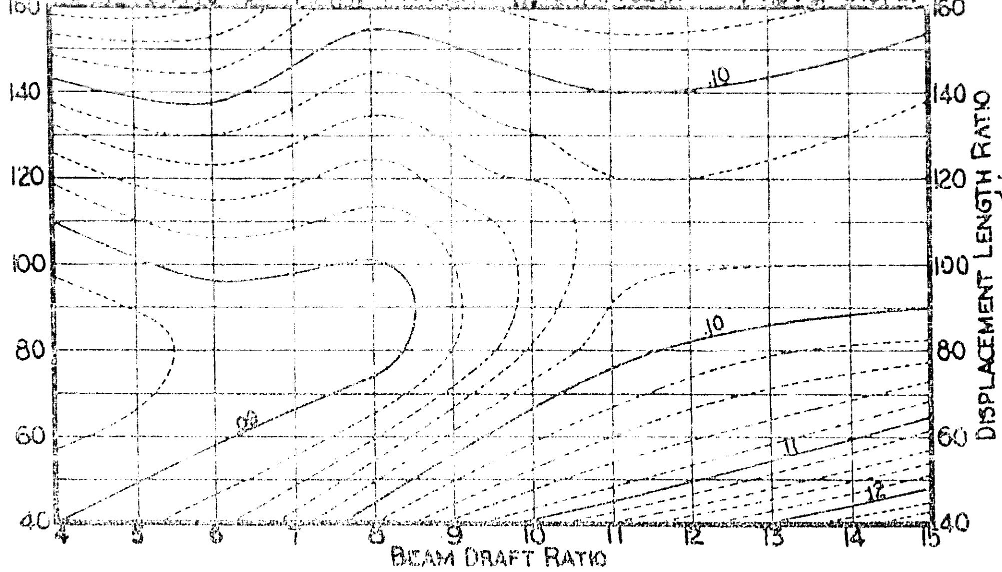
Speed-Length Ratios 1.5-6.5 in Steps of 0.5


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
0.07
0.06
0.07
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 1.5$
$\Delta = N$
$J = 0°$


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
.08
.09
.10
.11
.12
.13
.14
.12
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 1.5$
$\Delta = N$
$J = 2°$


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
.12
.13
.14
.15
.16
.17
.18
.19
.20
.21
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 1.5$
$\Delta = N$
$J = 4°$

CONTOURS OF TOTAL MODEL RESISTANCES LBS/LB. OF DISPL.

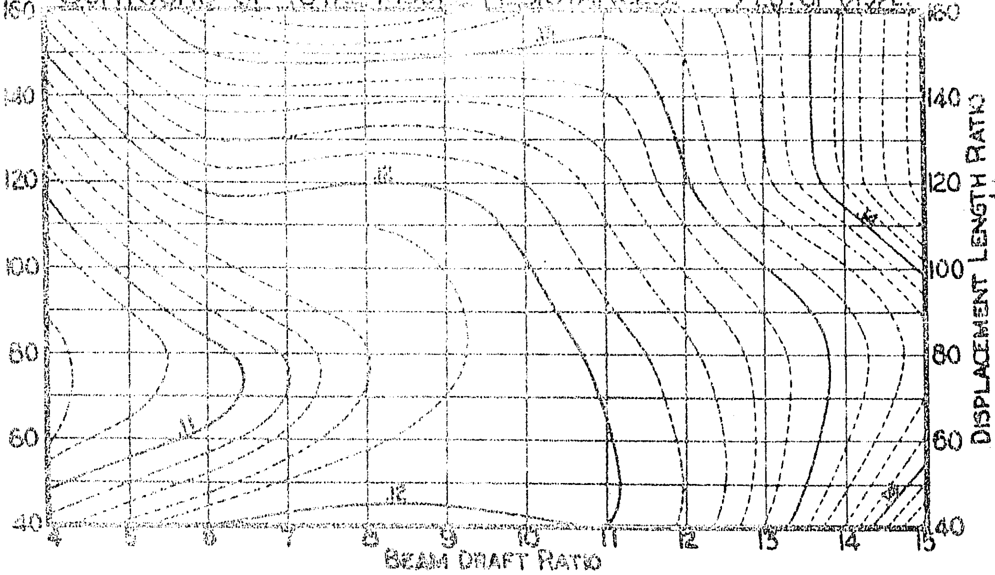


$\frac{V}{\sqrt{L}} = 2.0$

$\Delta =$ N

$\tau =$ 0°

CONTOURS OF TOTAL MODEL RESISTANCES LBS/LB. OF DISPL.



$\frac{V}{\sqrt{L}} = 2.0$

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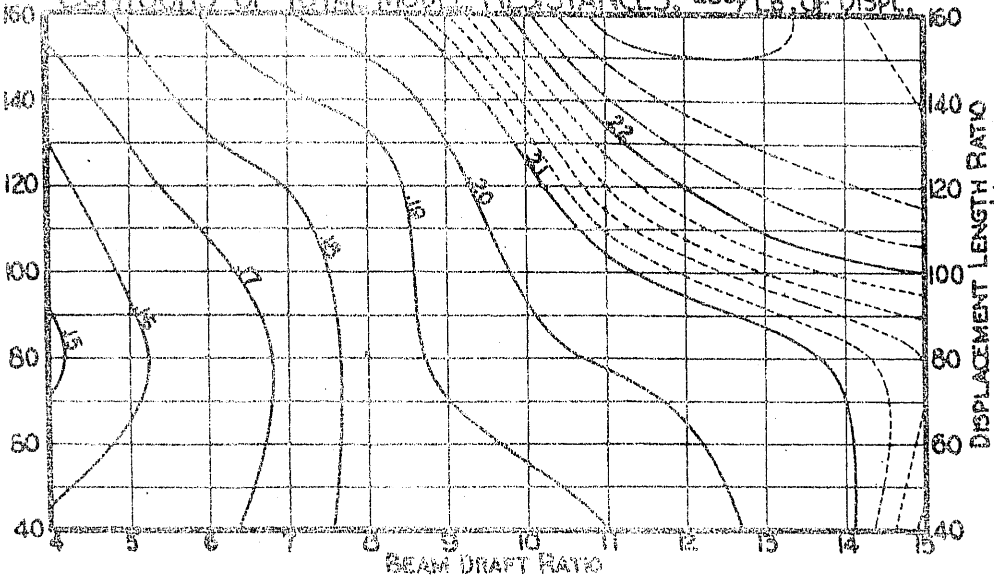
$\tau =$ 2°

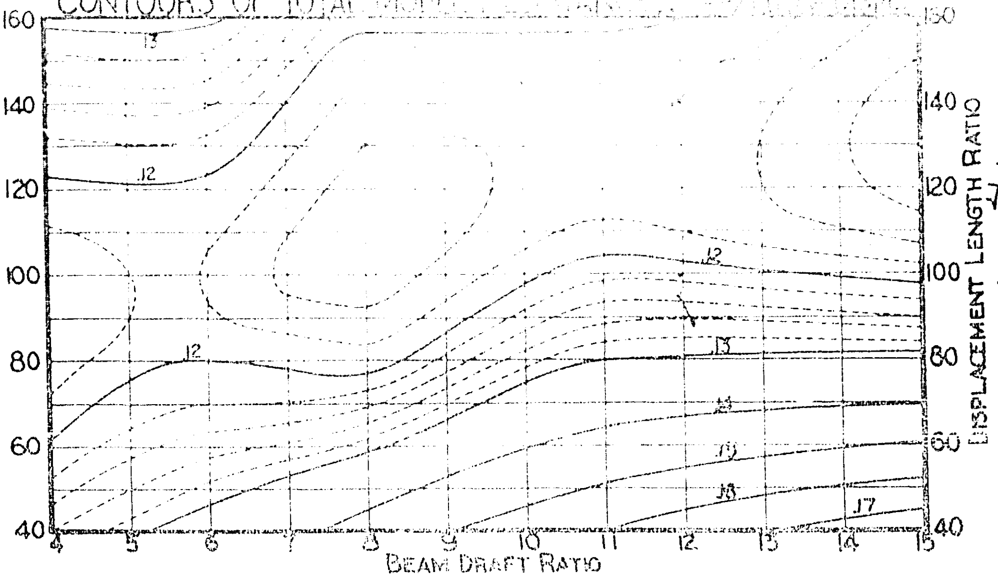
CONTOURS OF TOTAL MODEL RESISTANCES LBS/LB. OF DISPL.



$\frac{V}{\sqrt{L}} = 2.0$

$\Delta =$ N

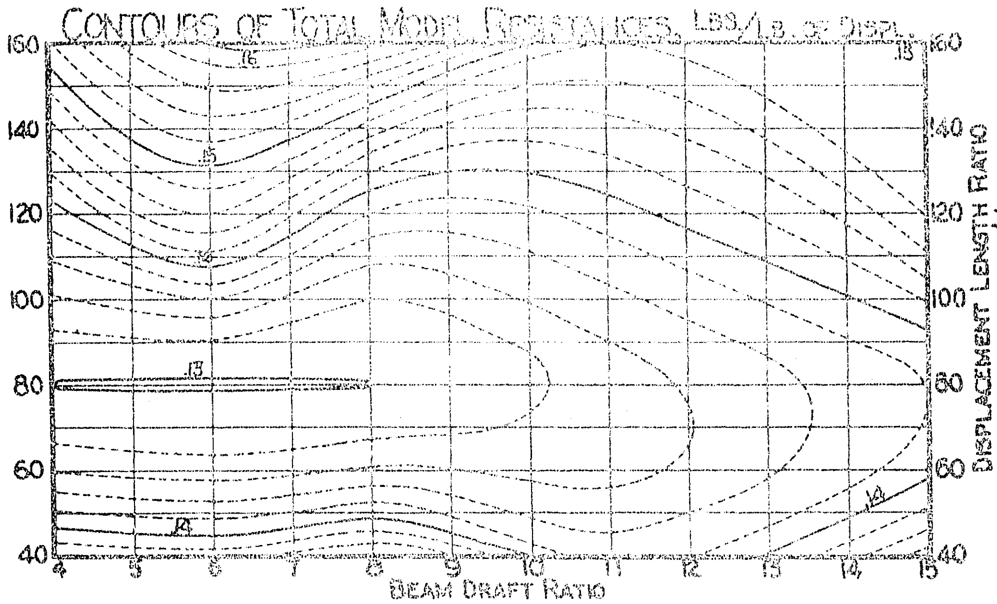
$\tau =$ 4°



$\frac{V}{\sqrt{L}} = 2.5$

$\Delta =$ N

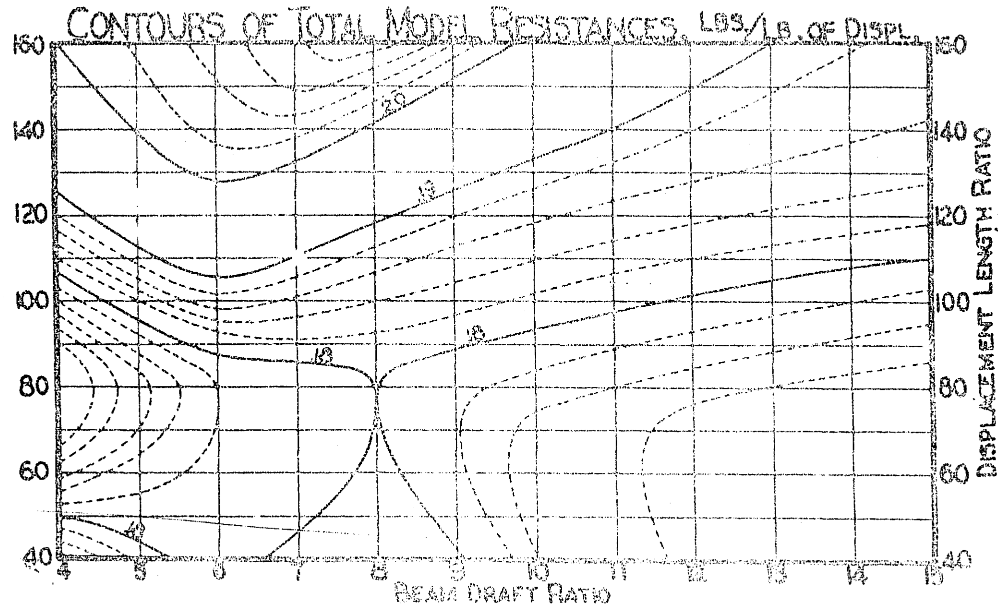
$J =$ 0°



$\frac{V}{\sqrt{L}} = 2.5$

$\Delta =$ N

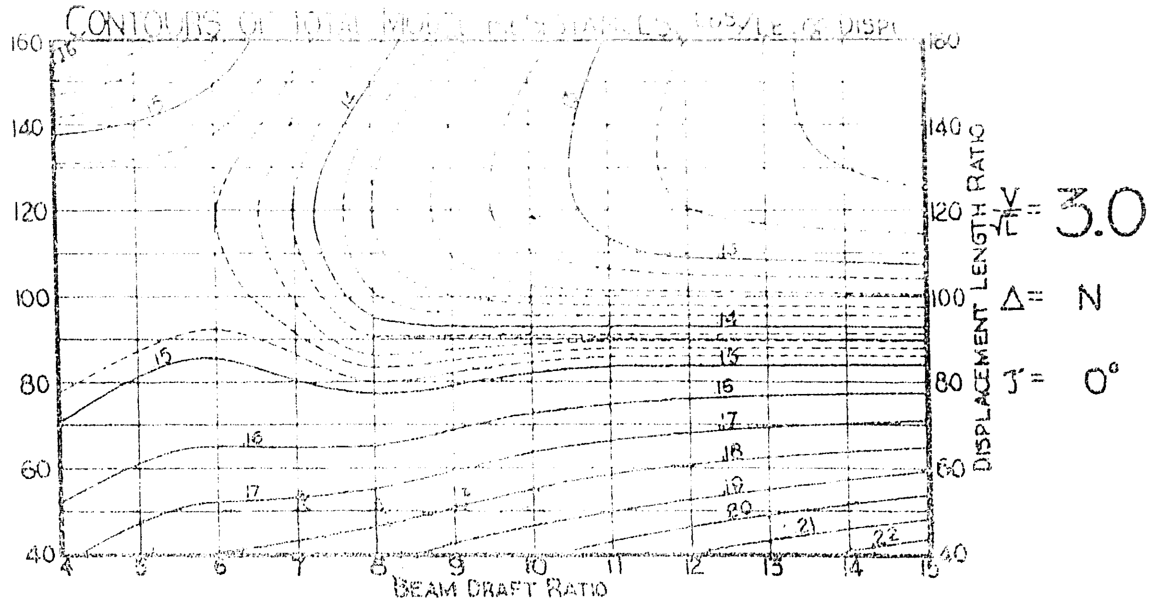
$J =$ 2°

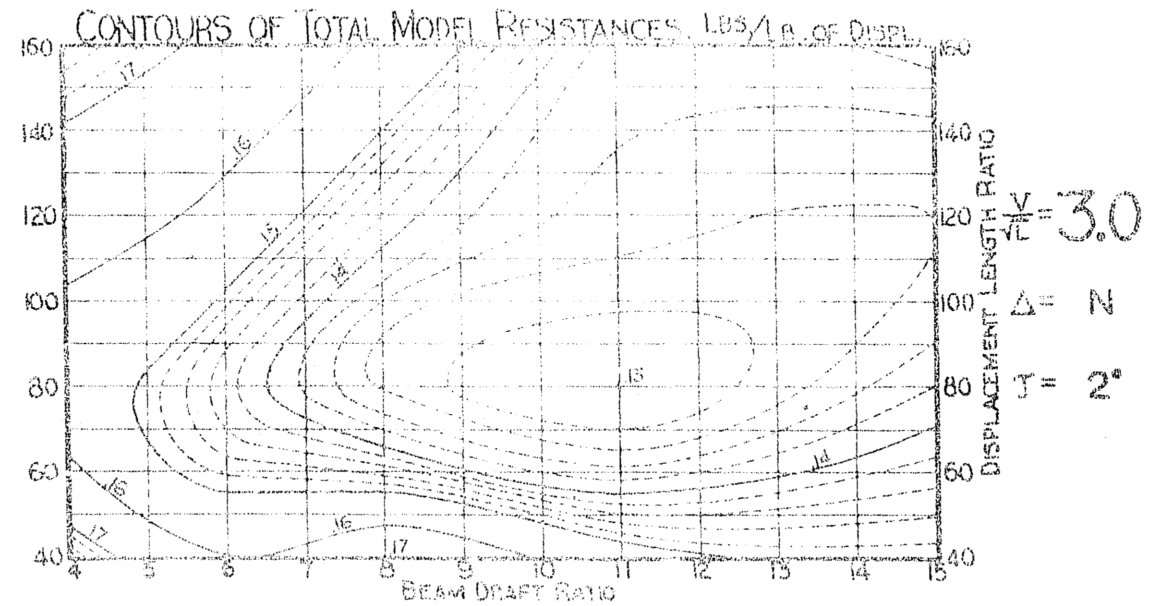


$\frac{V}{\sqrt{L}} = 2.5$

$\Delta =$ N

$J =$ 4°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 3.0$
$\Delta =$ N
$\tau = 0°$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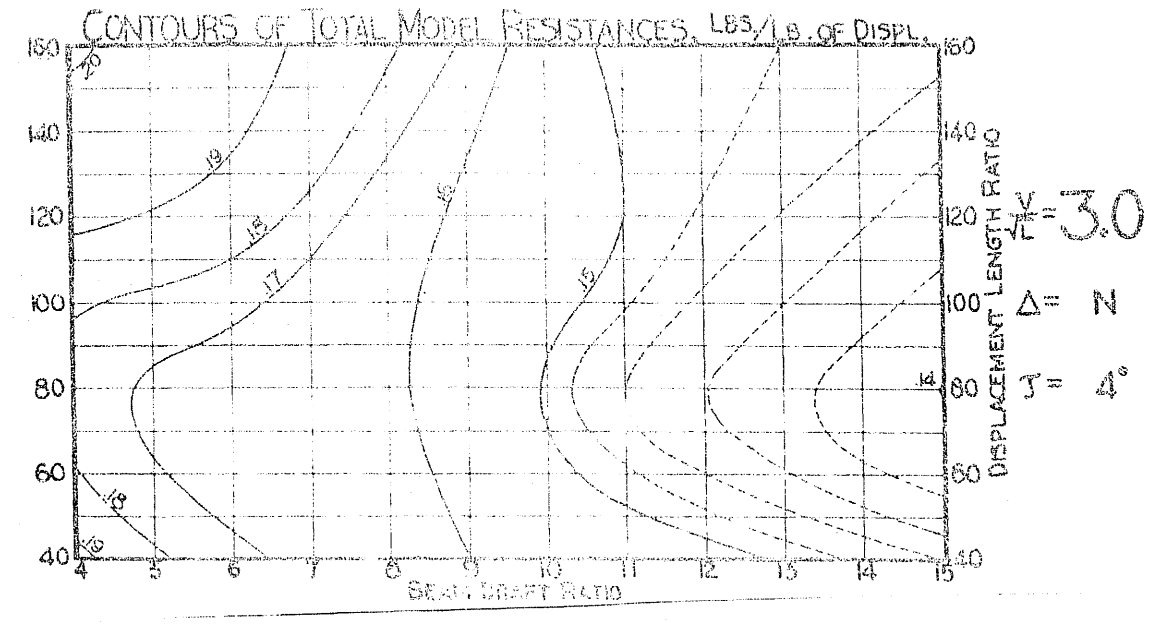
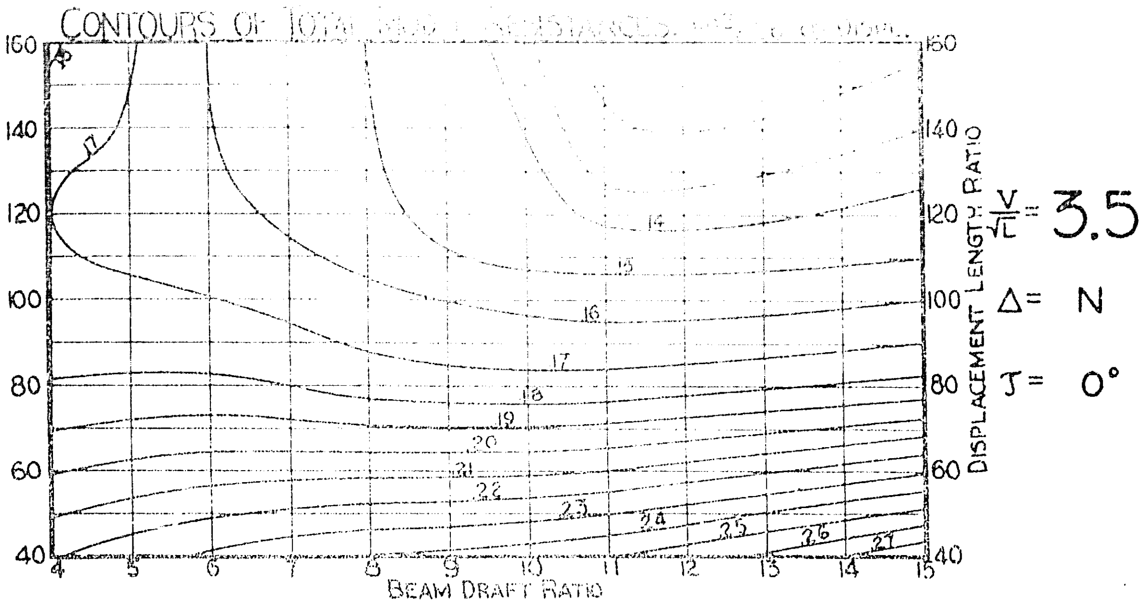
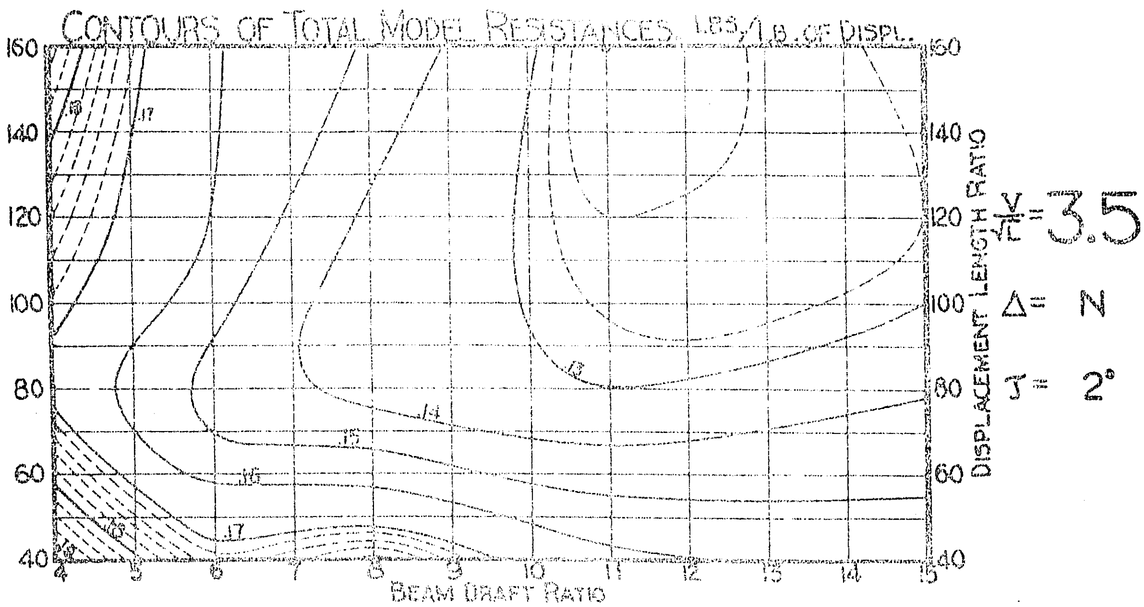
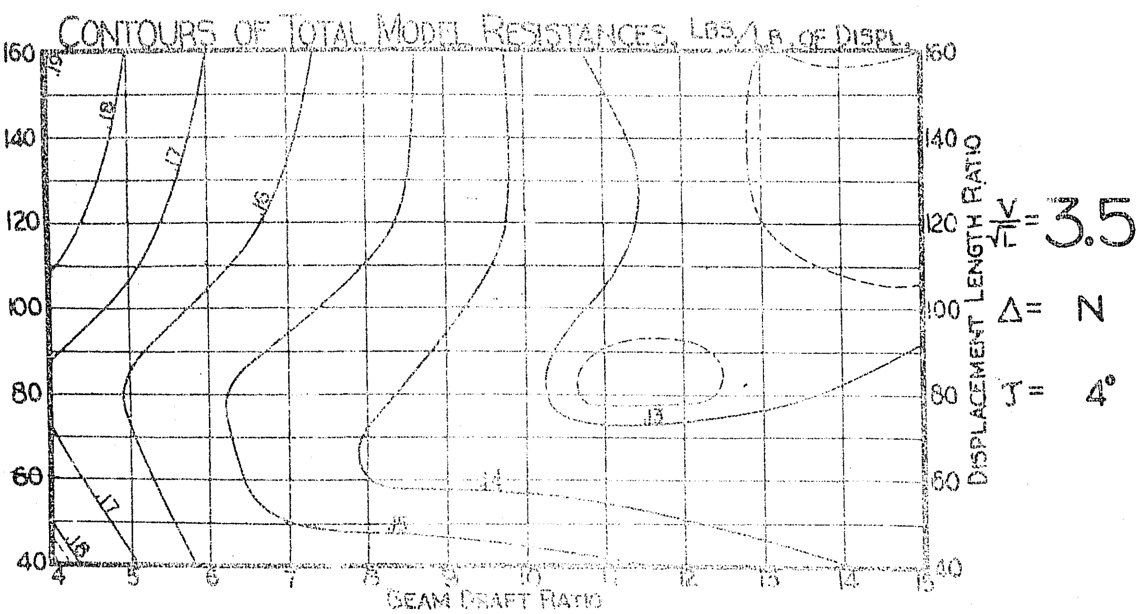
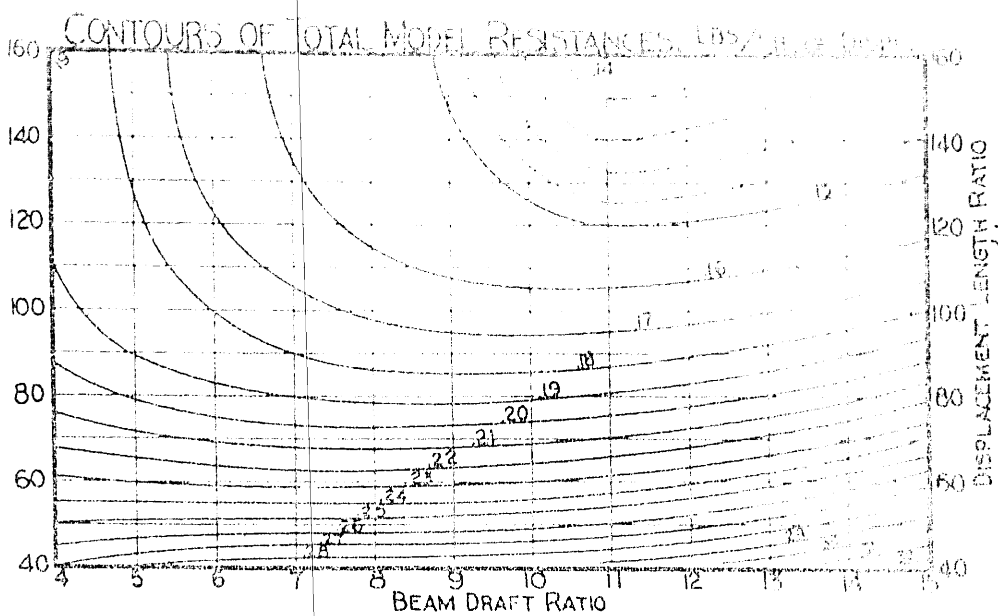

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 3.0$
$\Delta =$ N
$\tau = 4°$


CONTOURS OF
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.5$
Δ = N
τ = 0°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS./LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.5$
Δ = N
τ = 2°

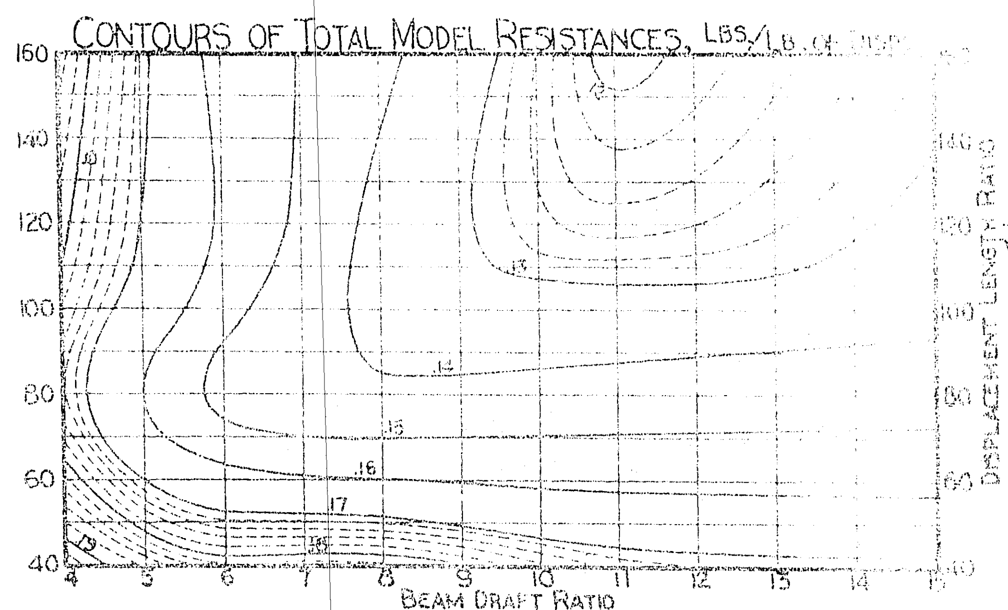

CONTOURS OF TOTAL MODEL RESISTANCES, LBS./LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.5$
Δ = N
τ = 4°



$\frac{V}{\sqrt{L}} = 4.0$

$\Delta =$ N

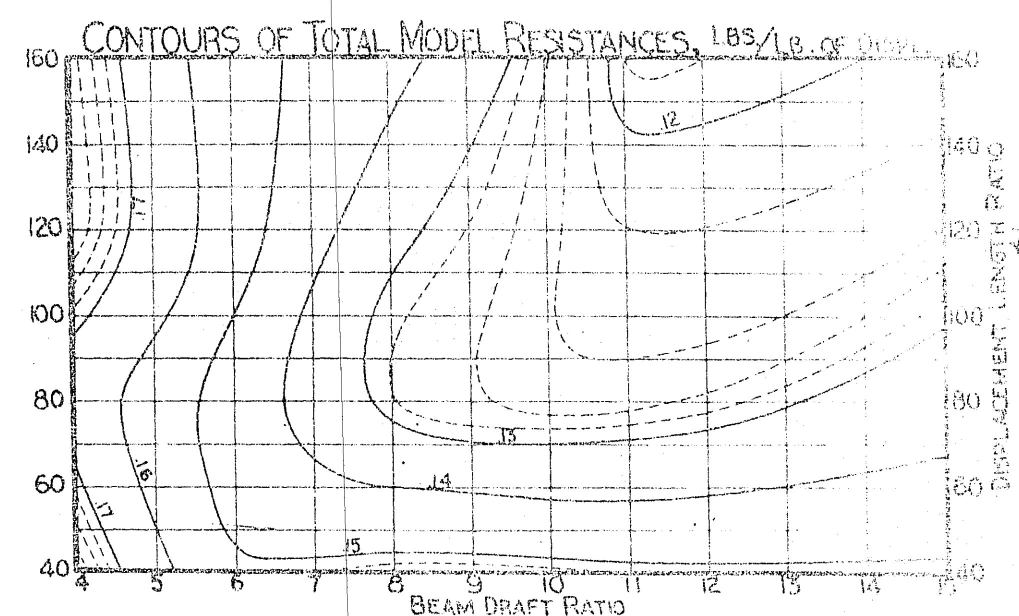
$\tau =$ 0°



$\frac{V}{\sqrt{L}} = 4.0$

$\Delta =$ N

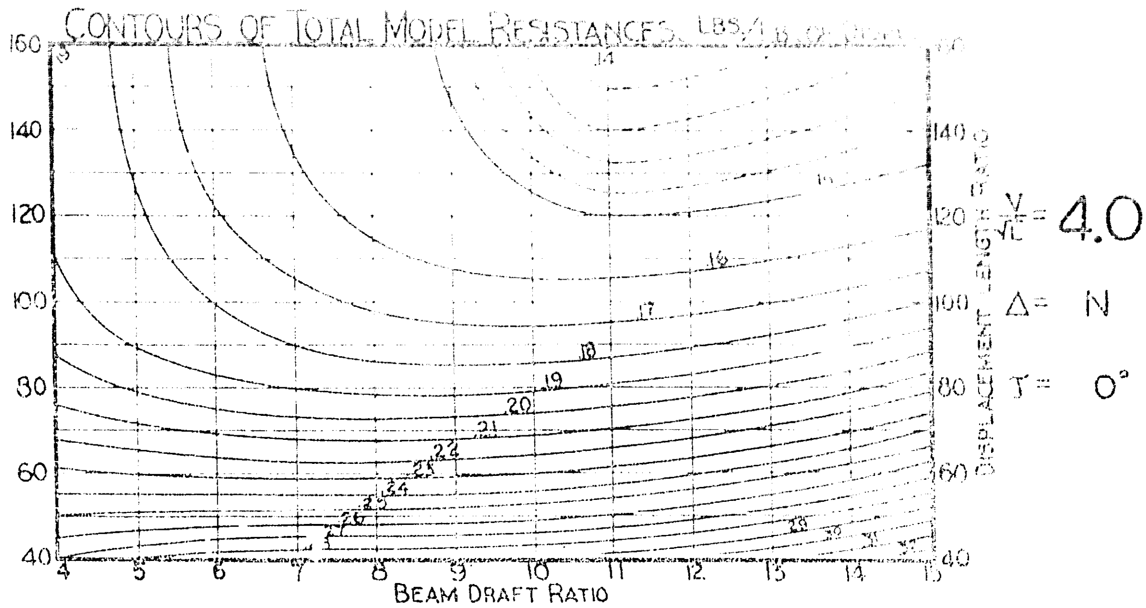
$\tau =$ 2°

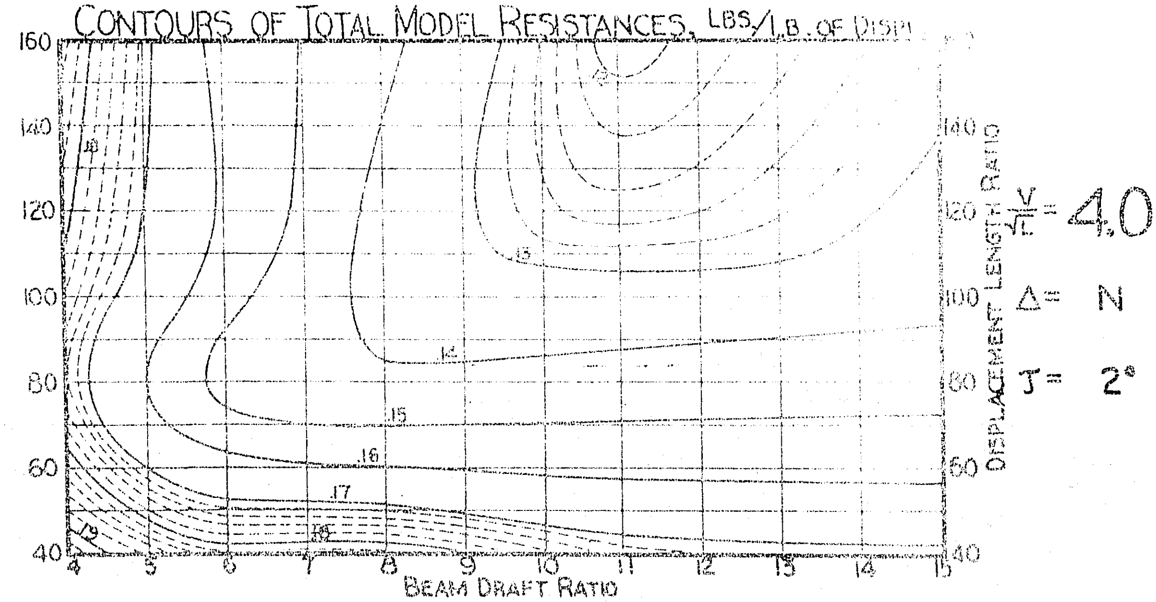


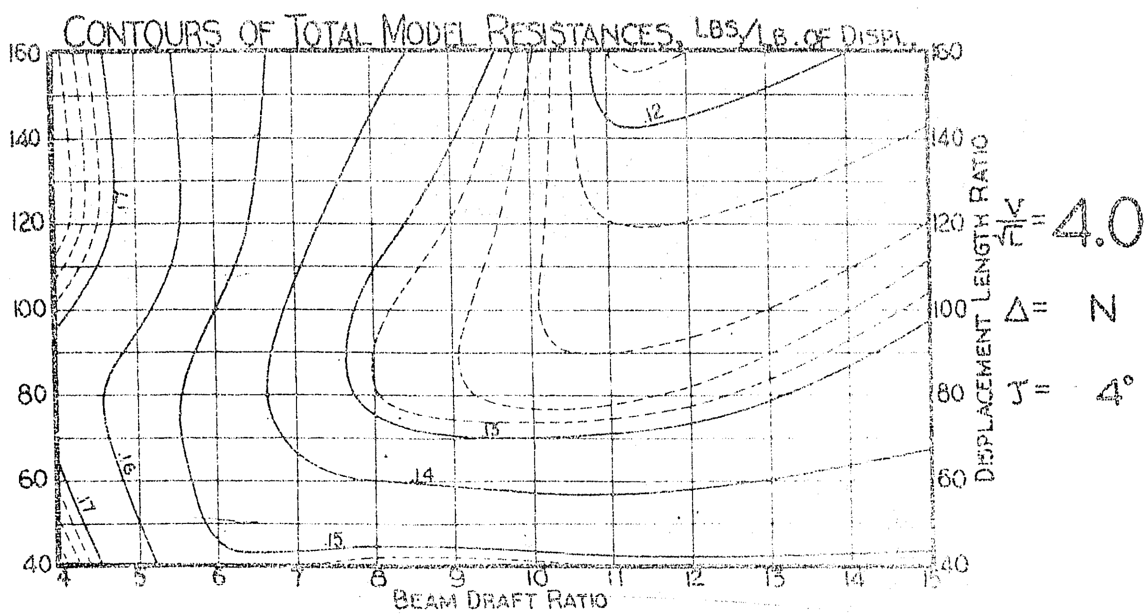
$\frac{V}{\sqrt{L}} = 4.0$

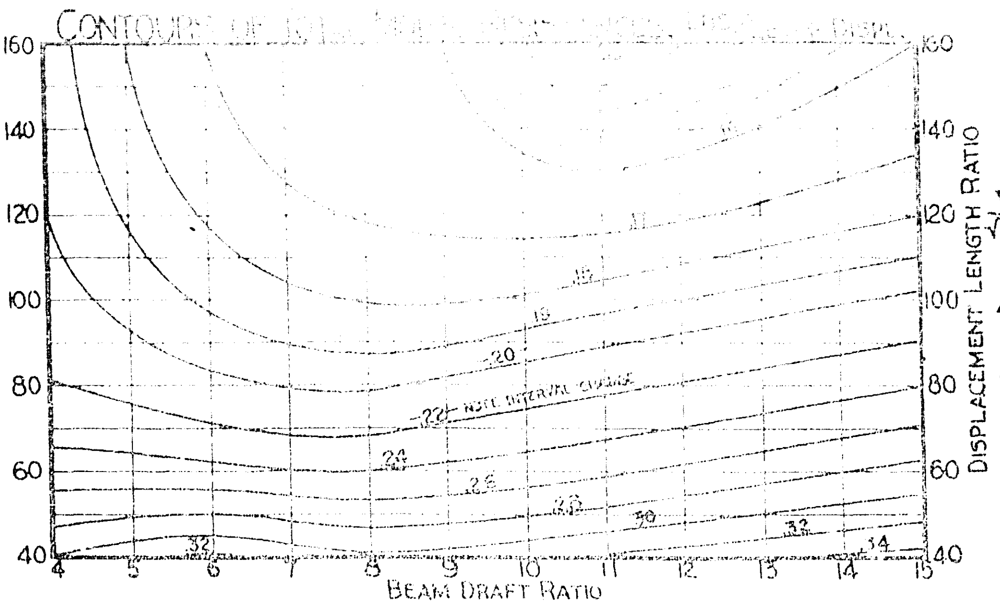
$\Delta =$ N

$\tau =$ 4°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 4.0$
Δ = N
J = 0°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 4.0$
Δ = N
J = 2°

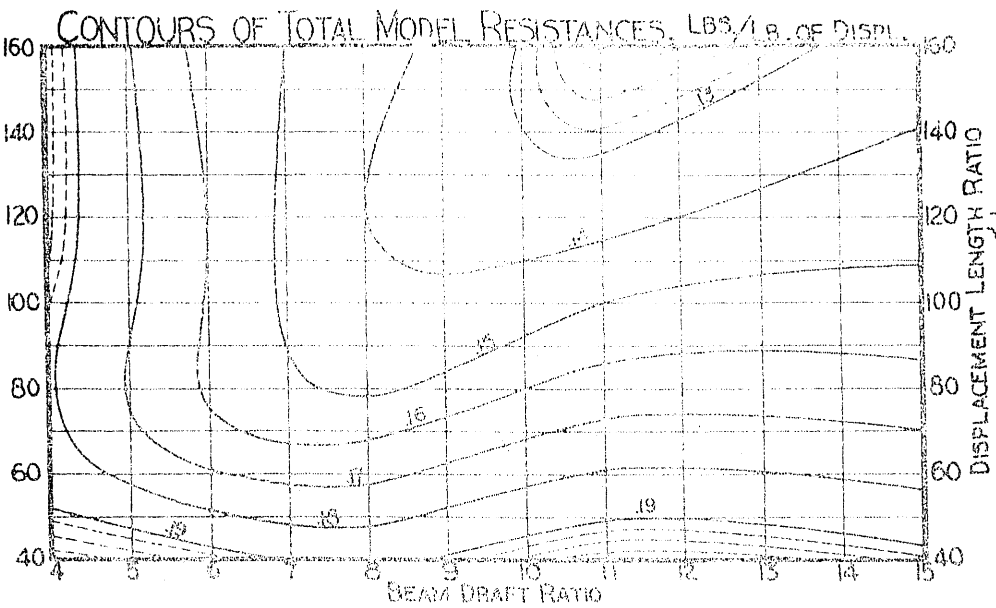

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 4.0$
Δ = N
J = 4°



$\frac{V}{\sqrt{L}} = 4.5$

$\Delta =$ N

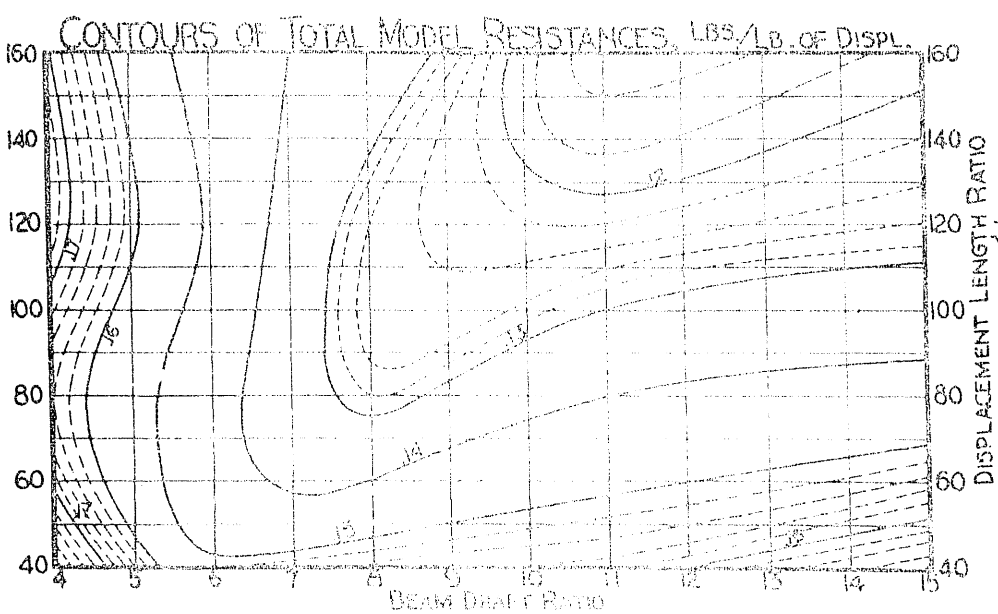
$\tau =$ 0°



$\frac{V}{\sqrt{L}} = 4.5$

$\Delta =$ N

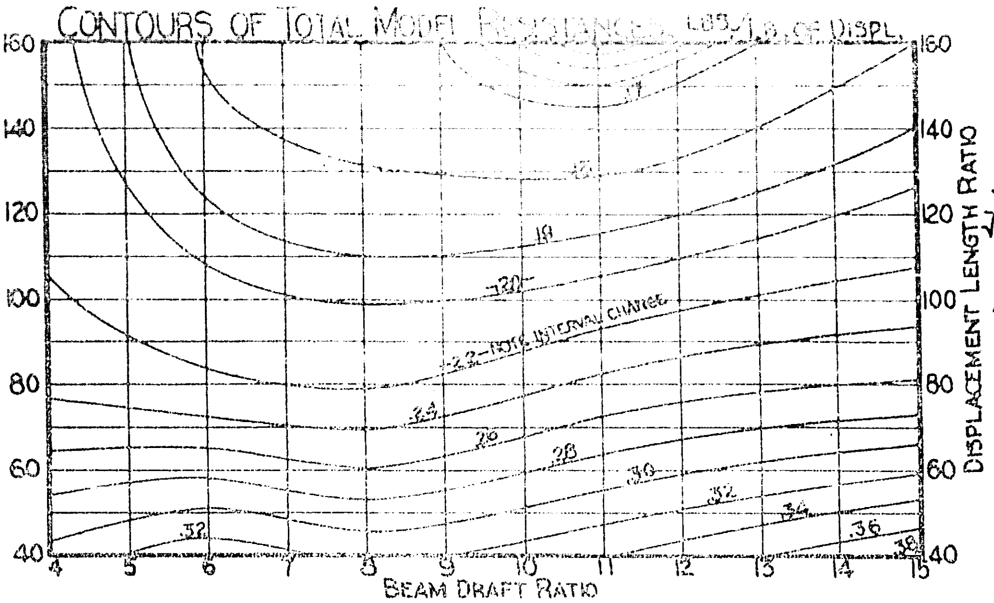
$\tau =$ 2°



$\frac{V}{\sqrt{L}} = 4.5$

$\Delta =$ N

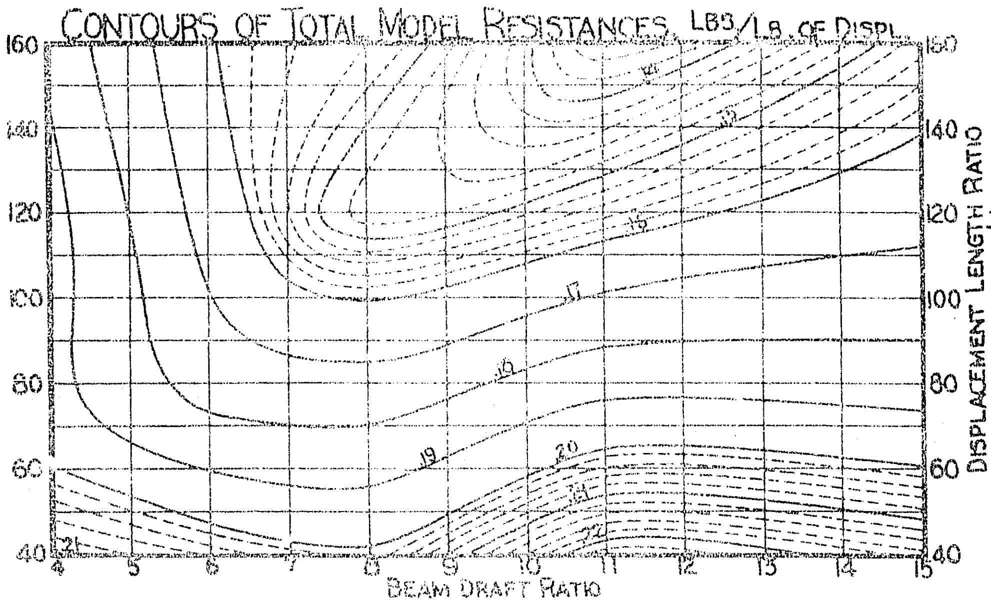
$\tau =$ 4°



$\frac{V}{\sqrt{L}} = 5.0$

Δ = N

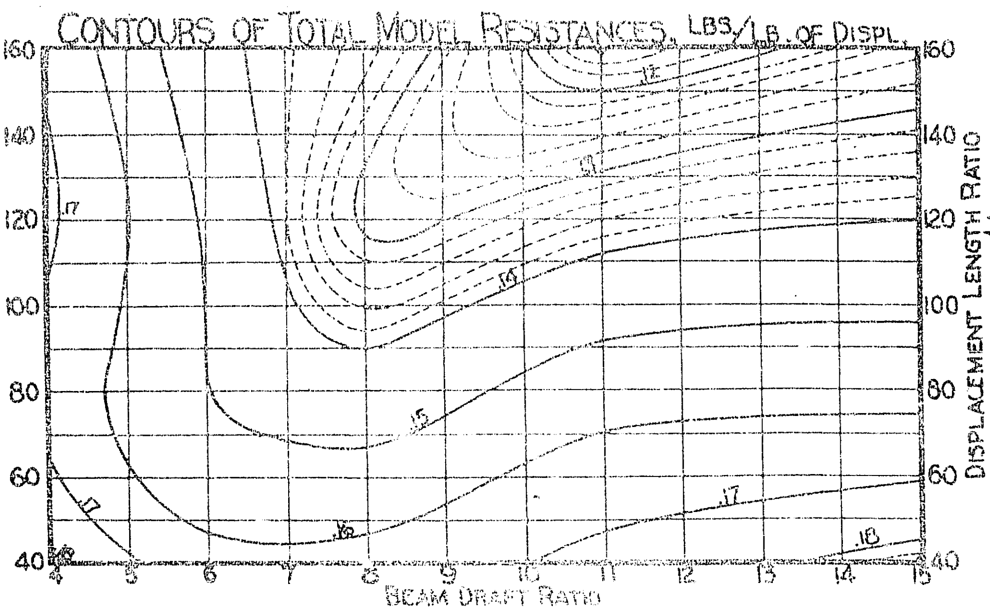
J = 0°



$\frac{V}{\sqrt{L}} = 5.0$

Δ = N

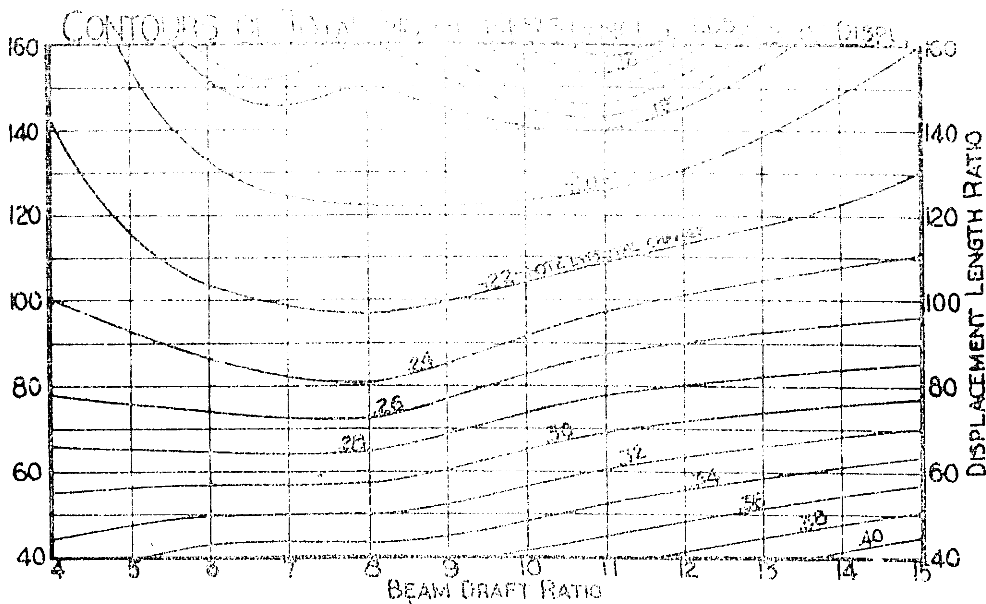
J = 2°



$\frac{V}{\sqrt{L}} = 5.0$

Δ = N

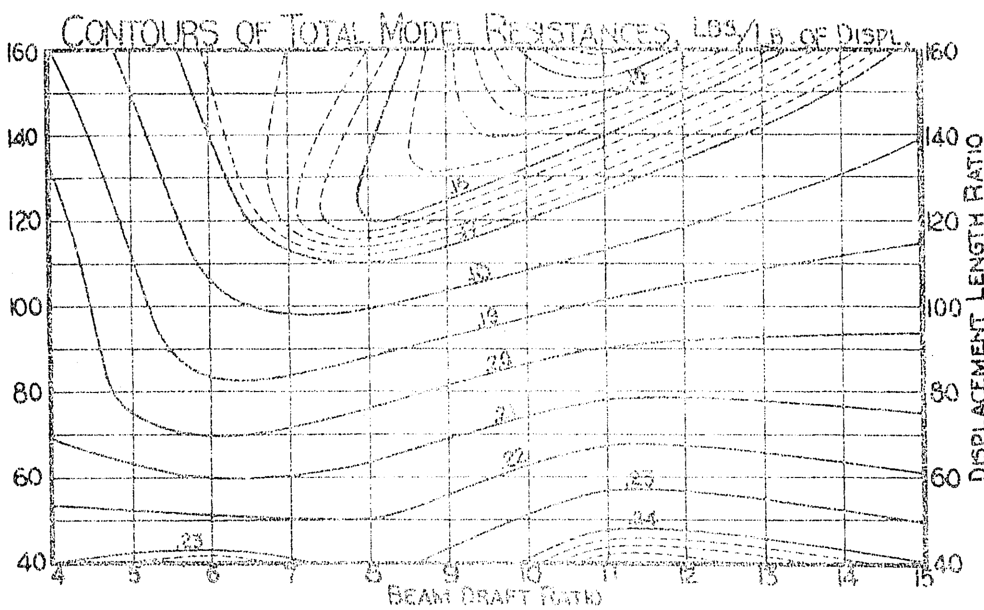
J = 4°



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta =$ N

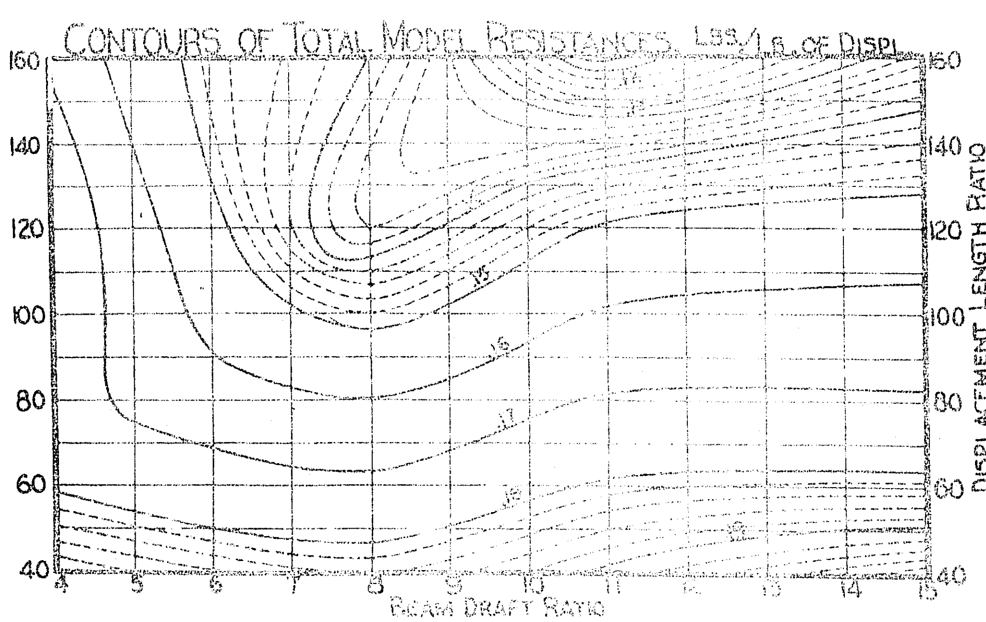
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta =$ N

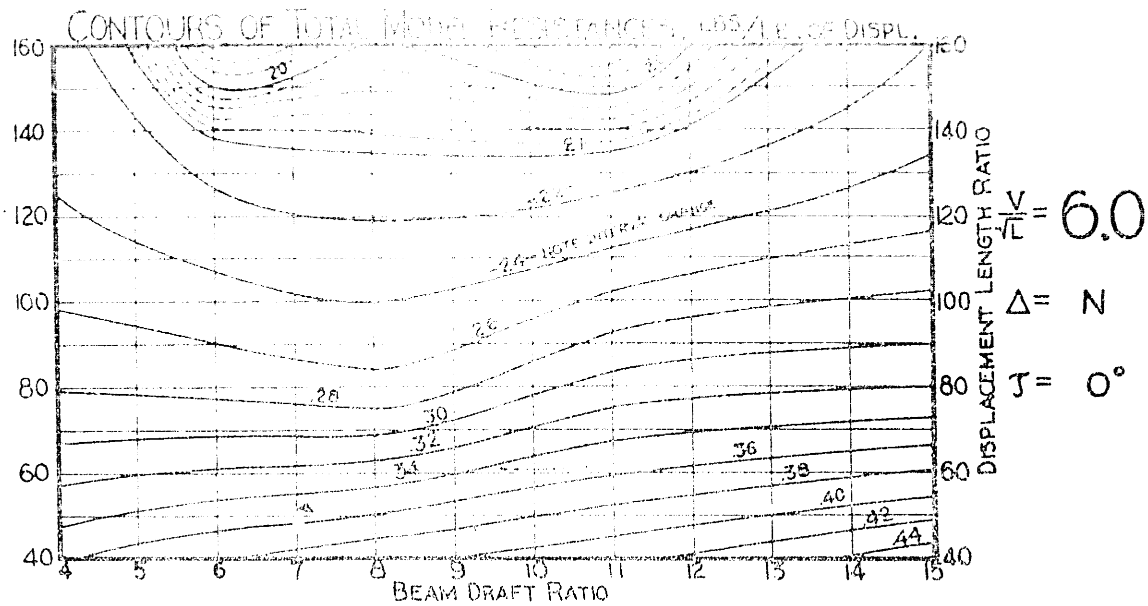
$\tau = 2°$

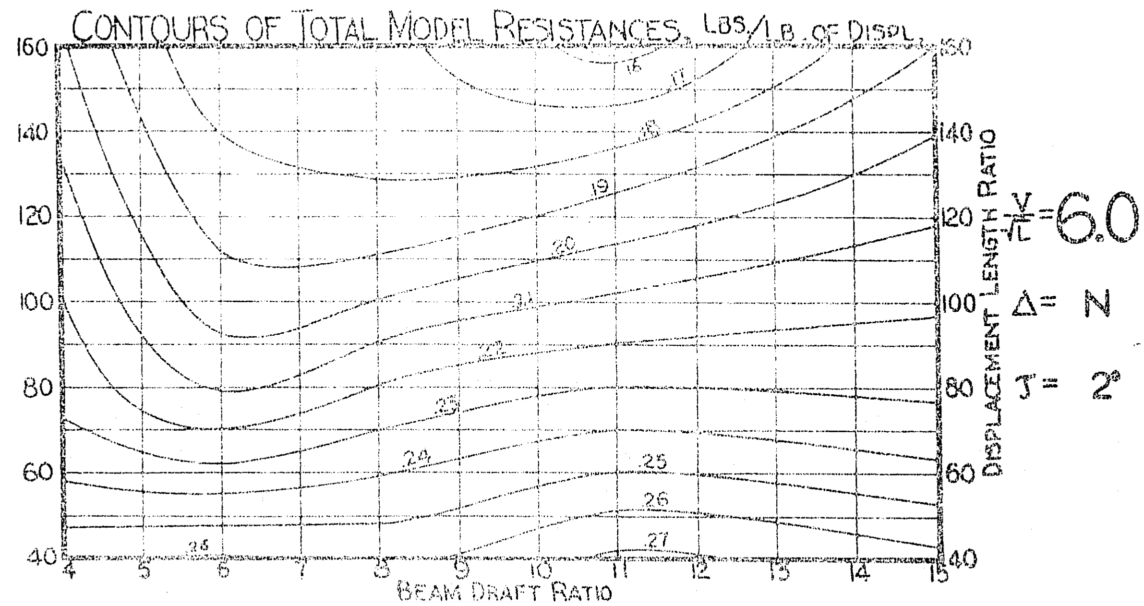


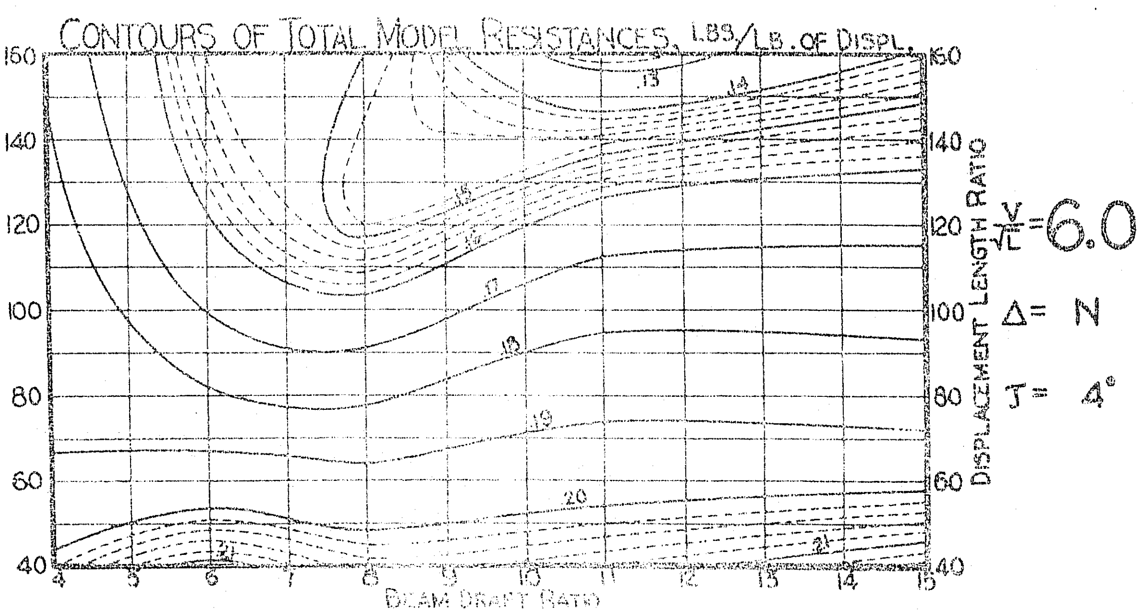
$\frac{V}{\sqrt{L}} = 5.5$

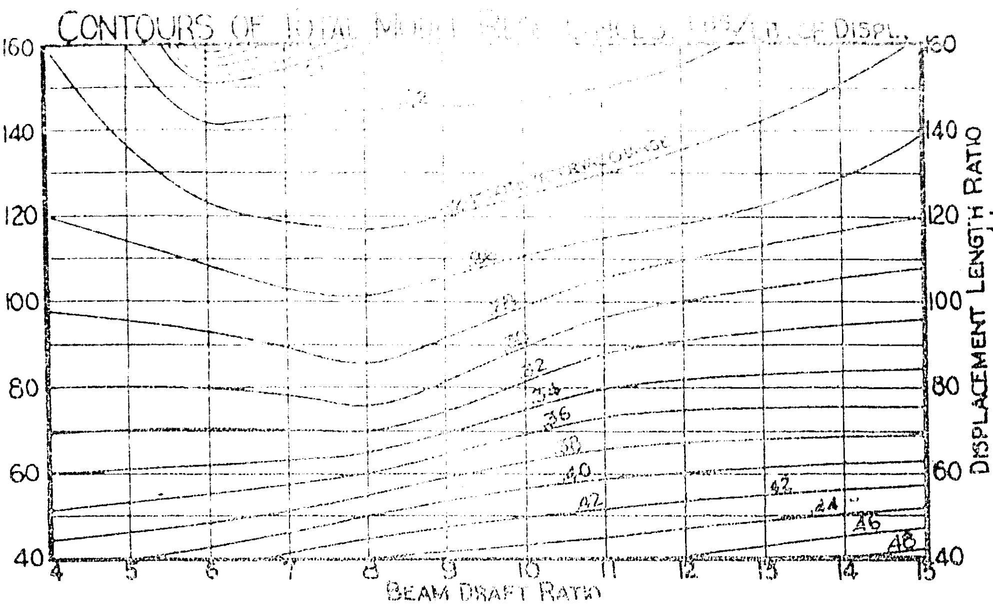
$\Delta =$ N

$\tau = 4°$


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 6.0$
Δ= N
J= 0°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 6.0$
Δ= N
J= 2°

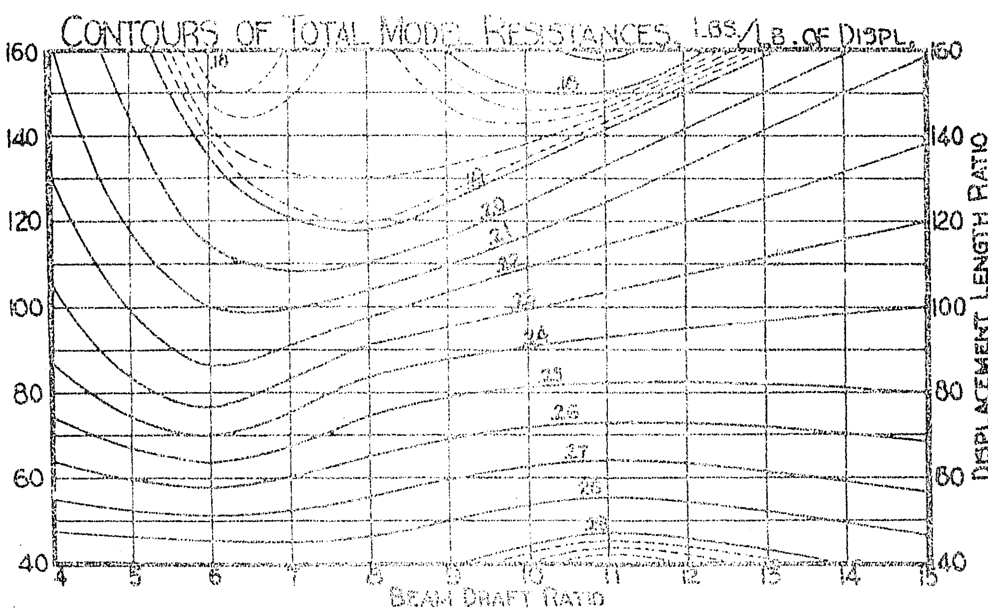

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 6.0$
Δ= N
J= 4°



$\frac{V}{\sqrt{L}} = 6.5$

$\Delta =$ N

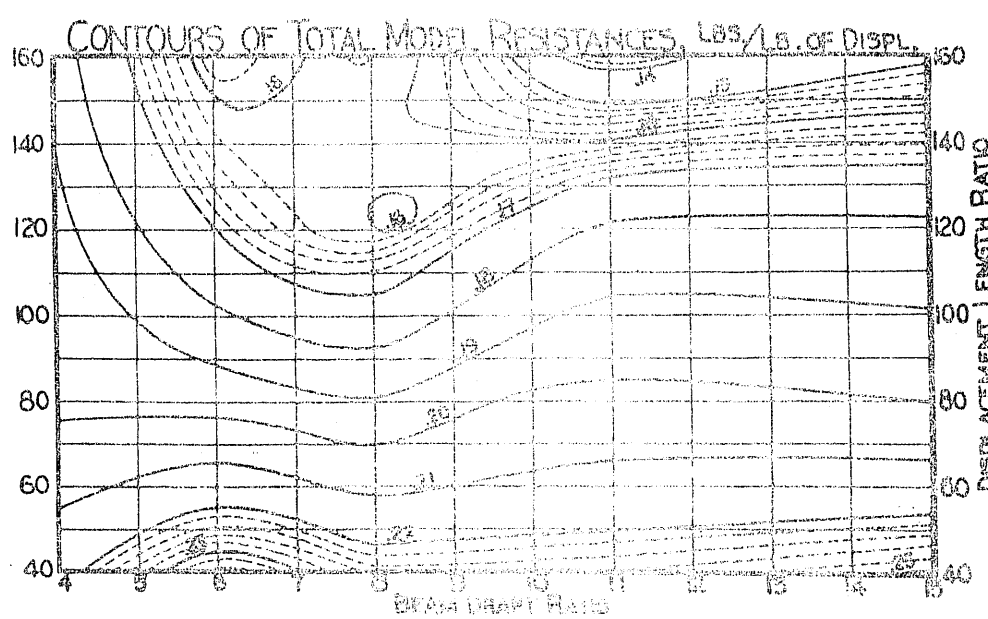
$\tau =$ 0°



$\frac{V}{\sqrt{L}} = 6.5$

$\Delta =$ N

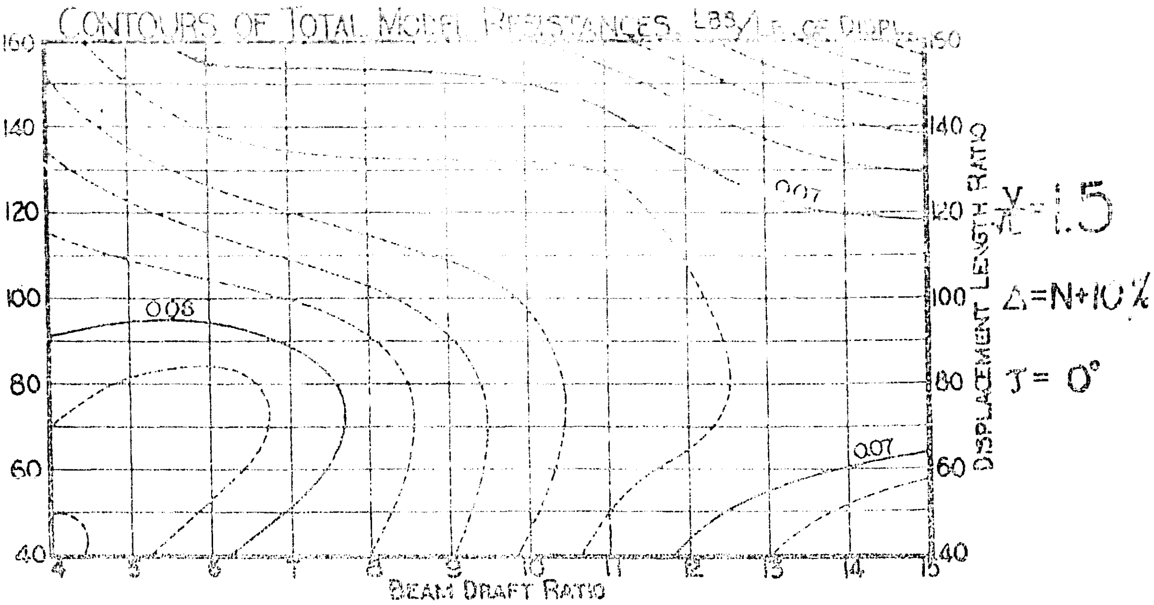
$\tau =$ 2°

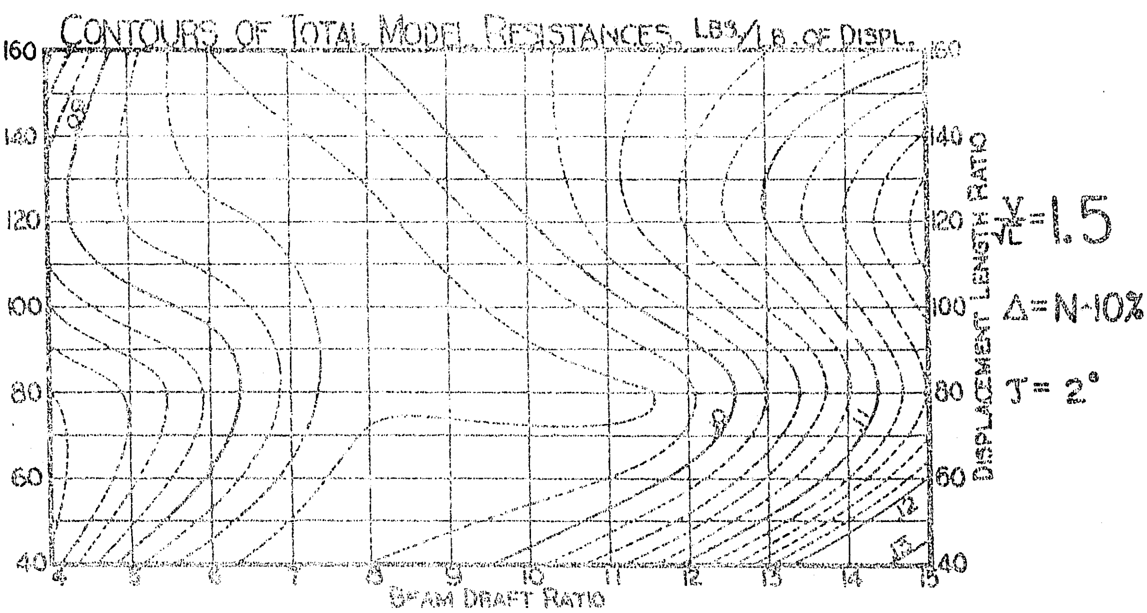


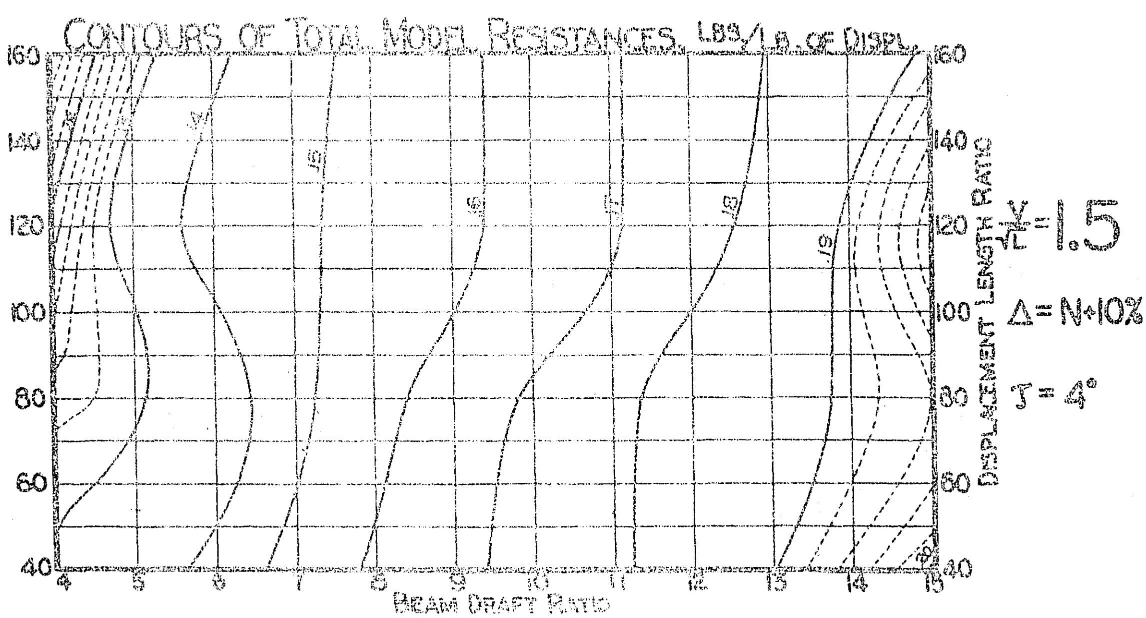
$\frac{V}{\sqrt{L}} = 6.5$

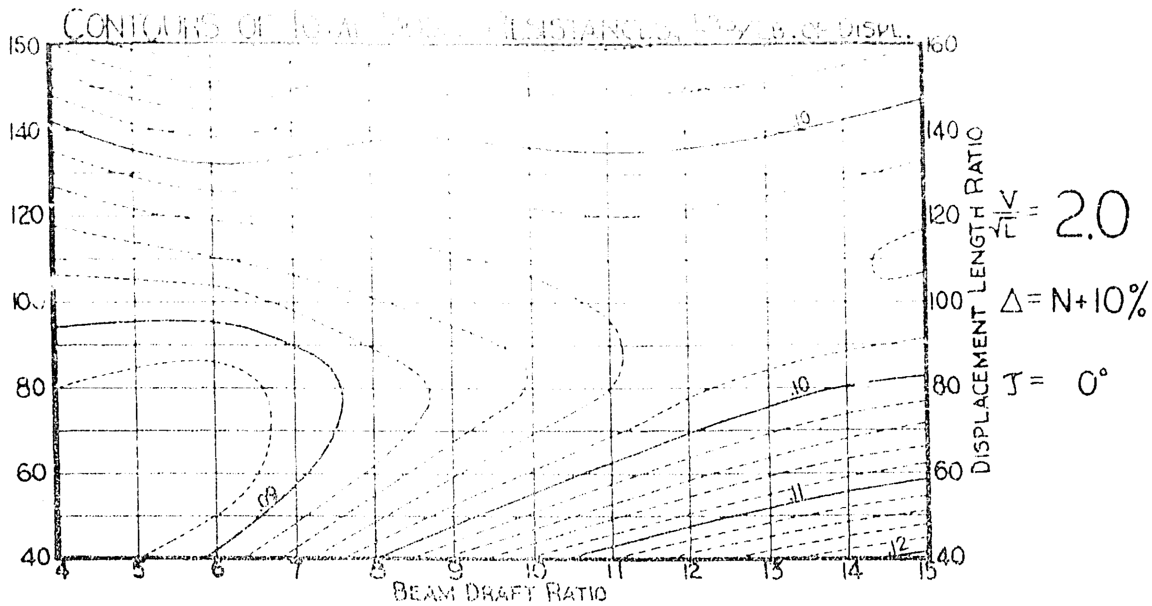
$\Delta =$ N

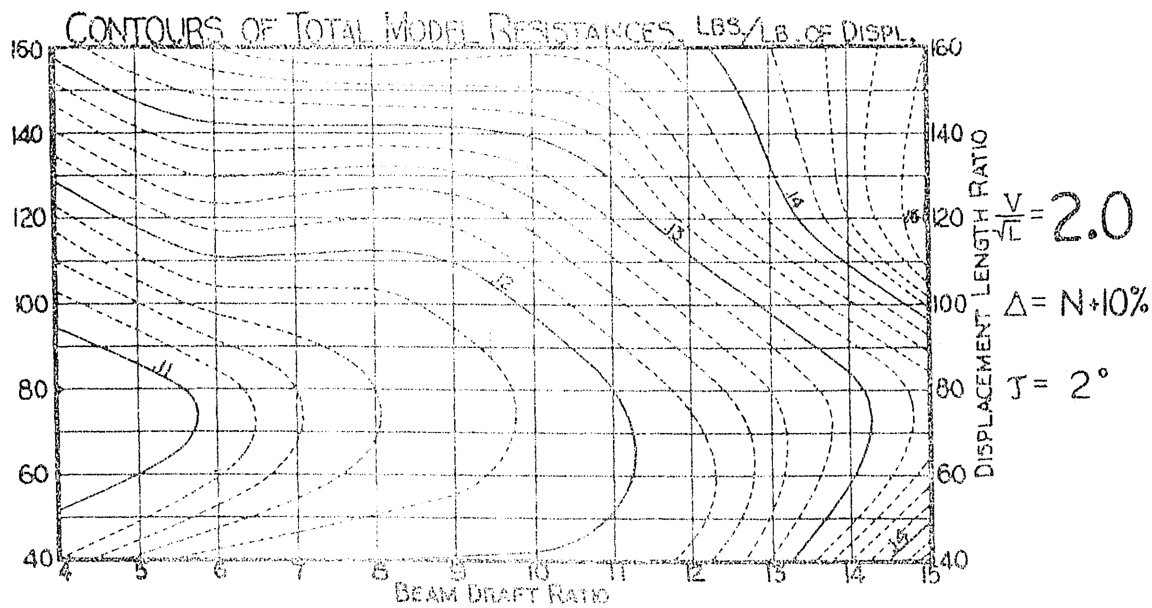
$\tau =$ 4°

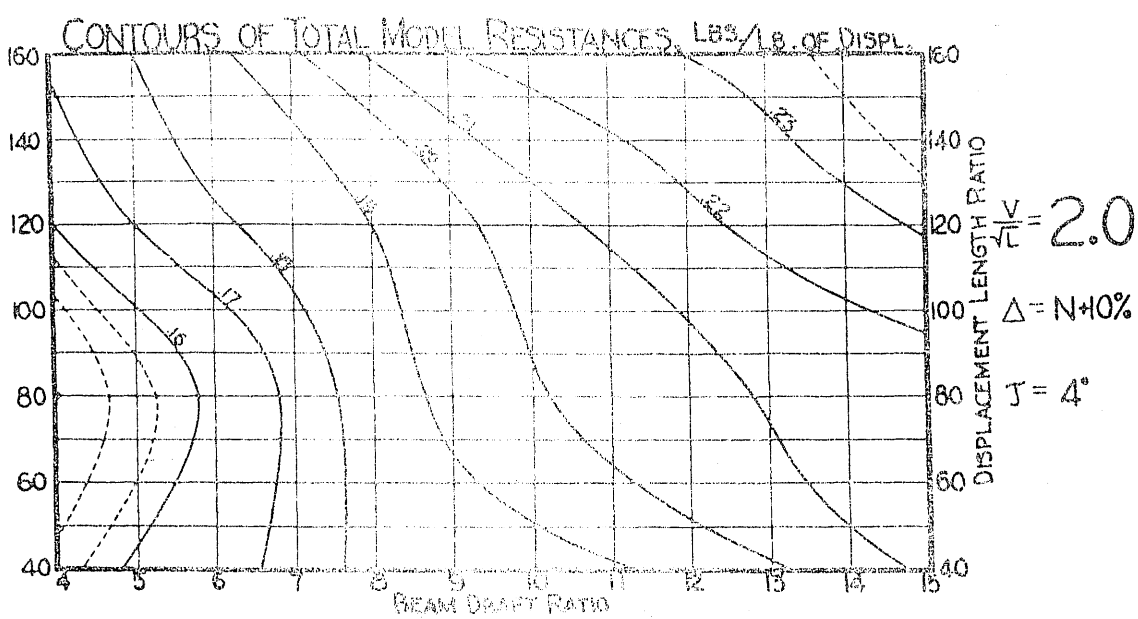

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
0.06
0.07
$\frac{V}{\sqrt{L}} = 1.5$
$\Delta = N+10\%$
$\tau = 0°$

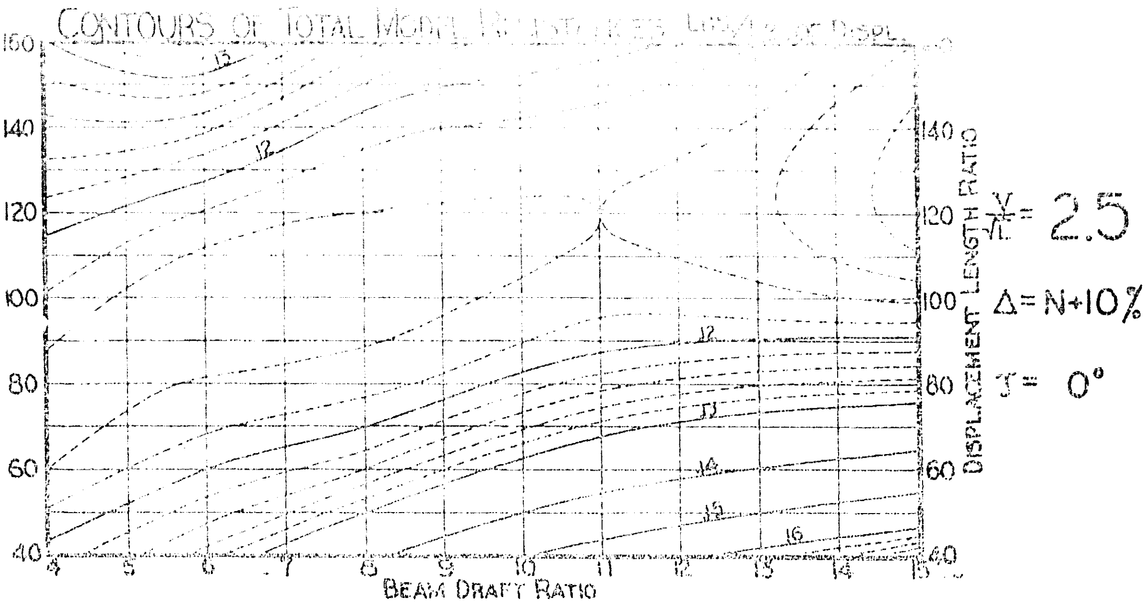

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 1.5$
$\Delta = N-10\%$
$\tau = 2°$

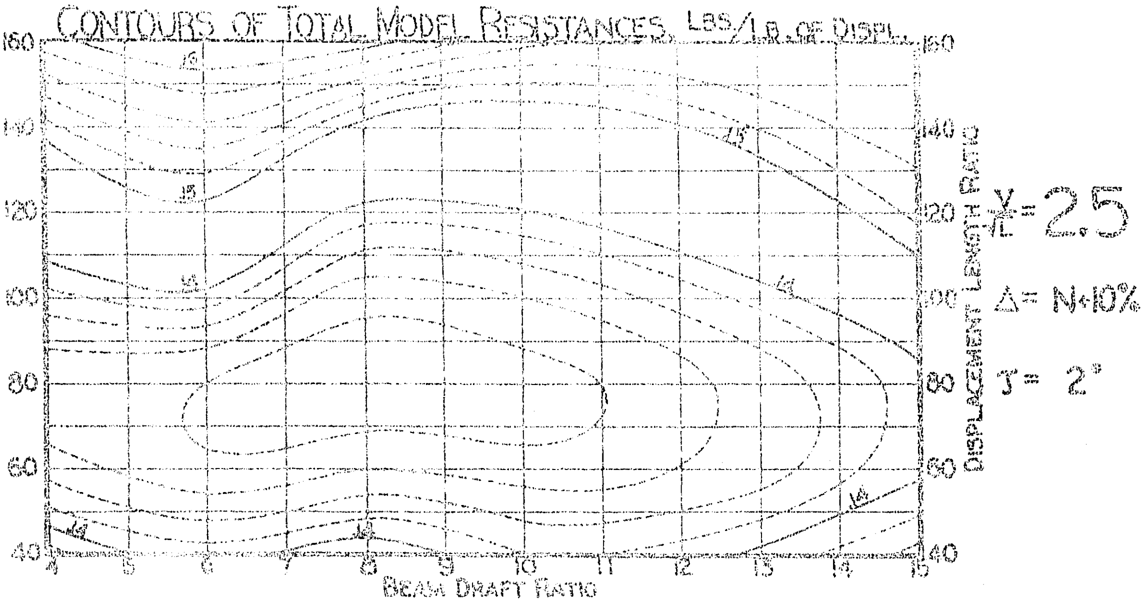

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
.14
.15
.16
.17
.18
.19
$\frac{V}{\sqrt{L}} = 1.5$
$\Delta = N+10\%$
$\tau = 4°$

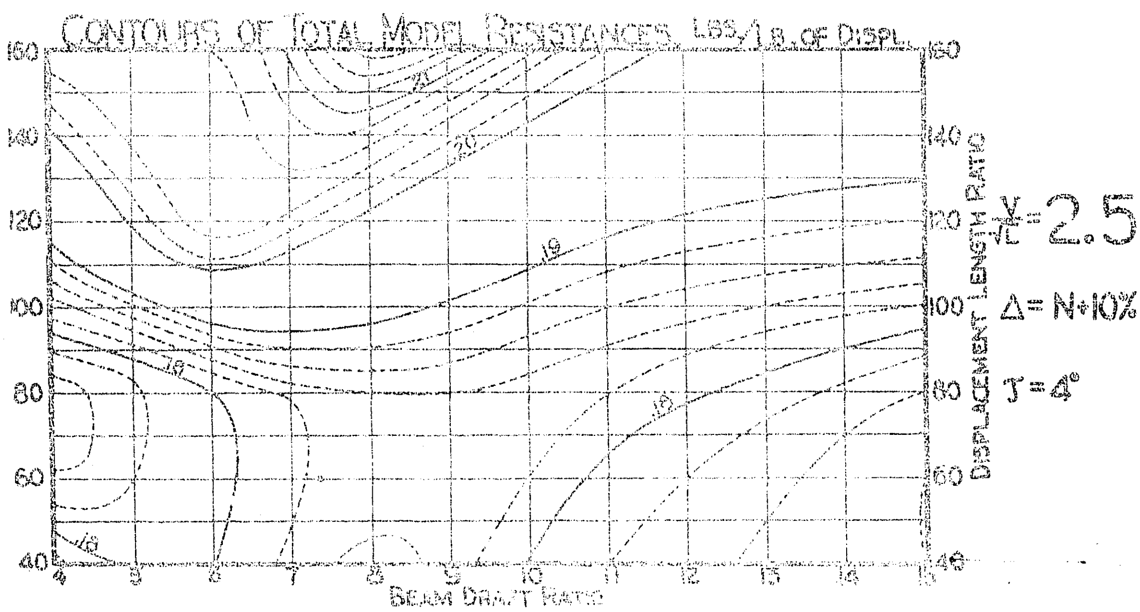

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 2.0$
$\Delta = N+10\%$
$\tau = 0°$

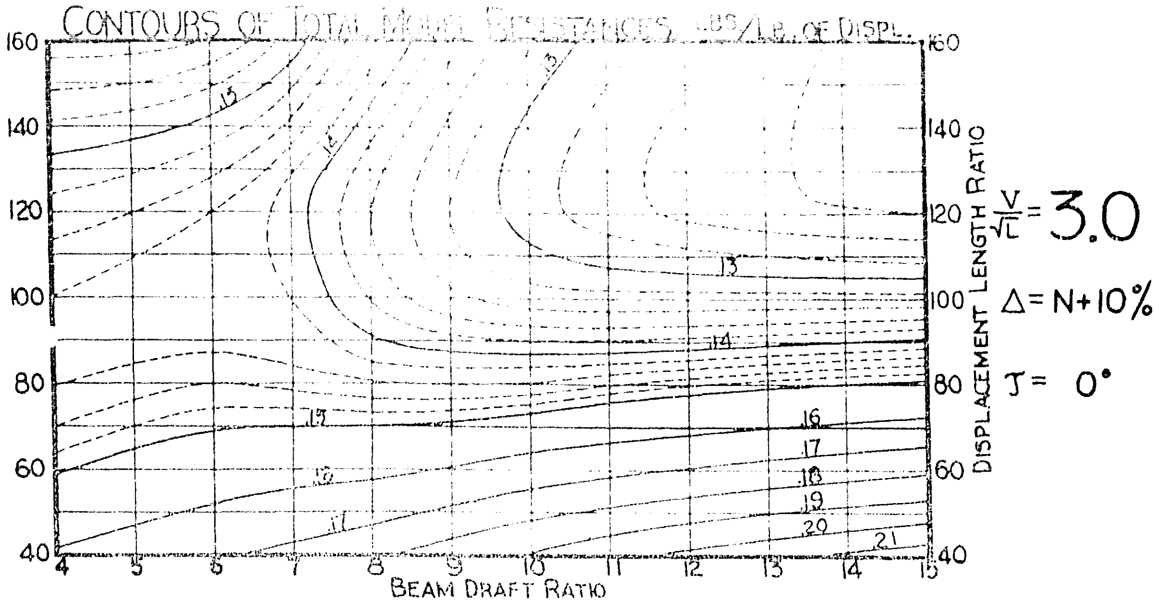

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 2.0$
$\Delta = N+10\%$
$\tau = 2°$

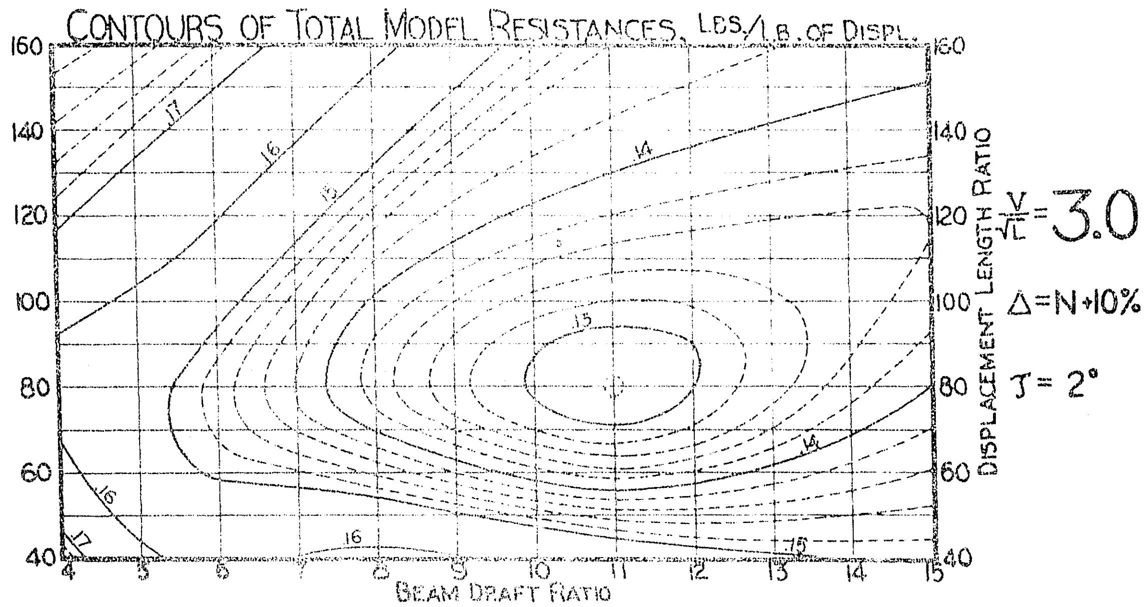

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 2.0$
$\Delta = N+10\%$
$\tau = 4°$

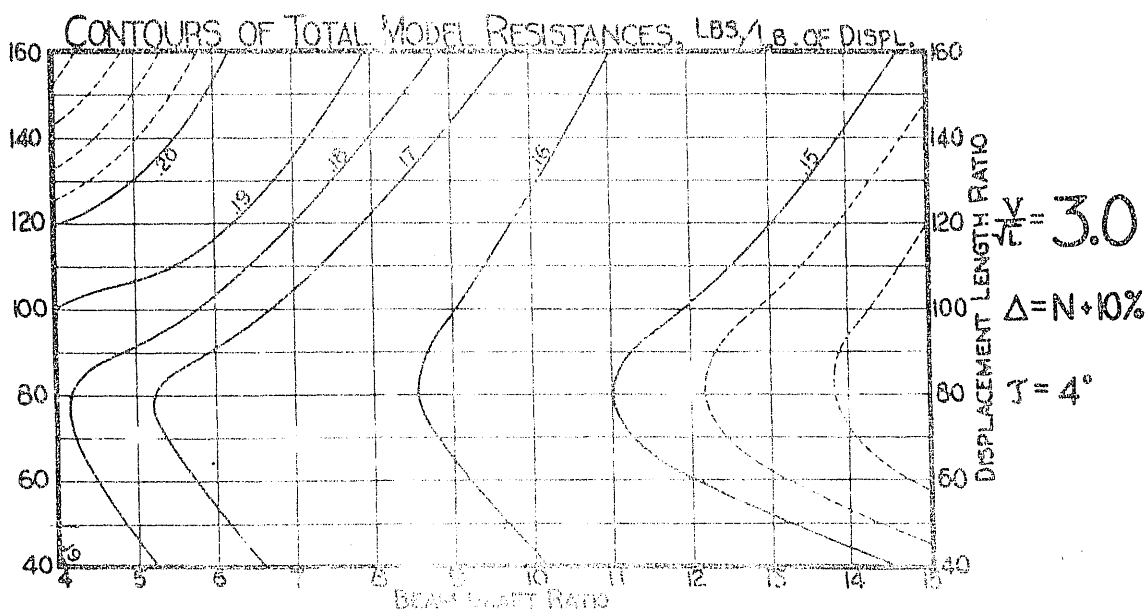

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 2.5$
$\Delta = N + 10\%$
$\tau = 0°$

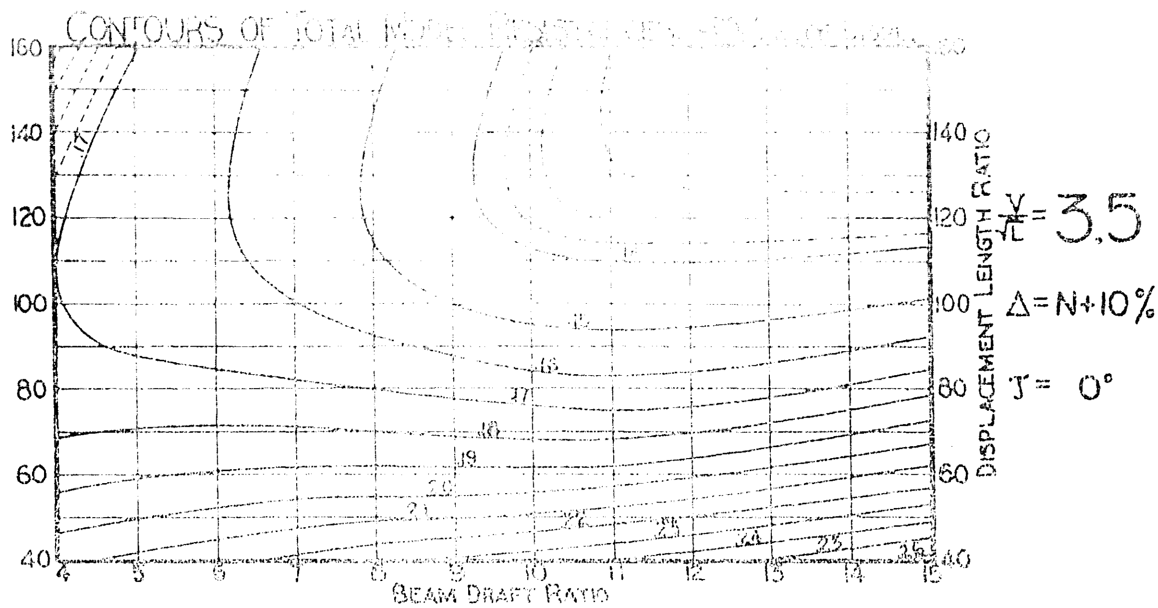

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 2.5$
$\Delta = N + 10\%$
$\tau = 2°$

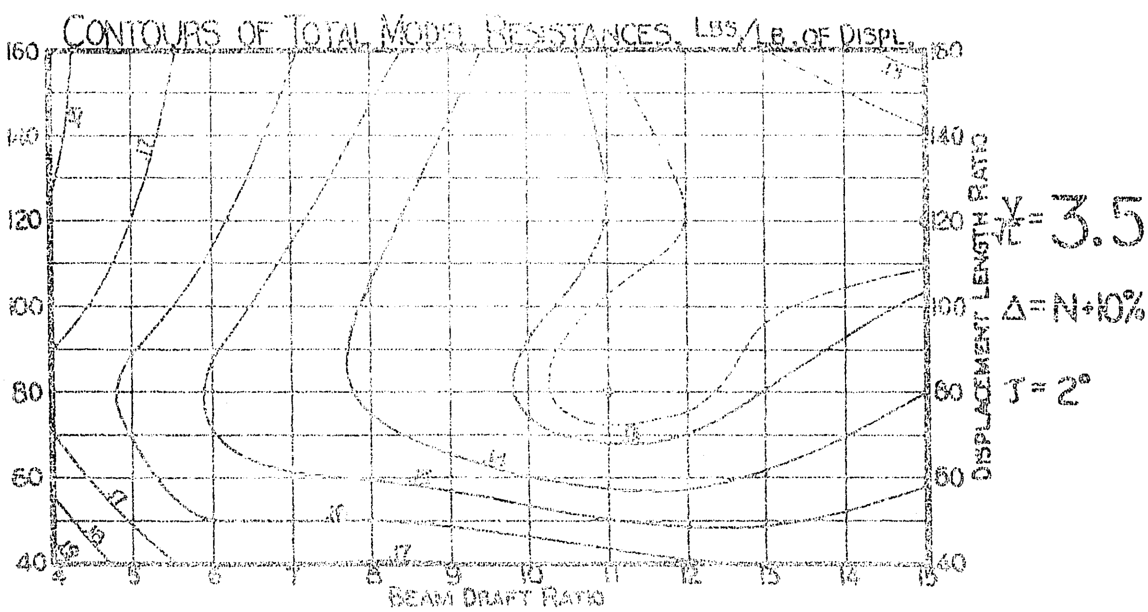

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 2.5$
$\Delta = N + 10\%$
$\tau = 4°$

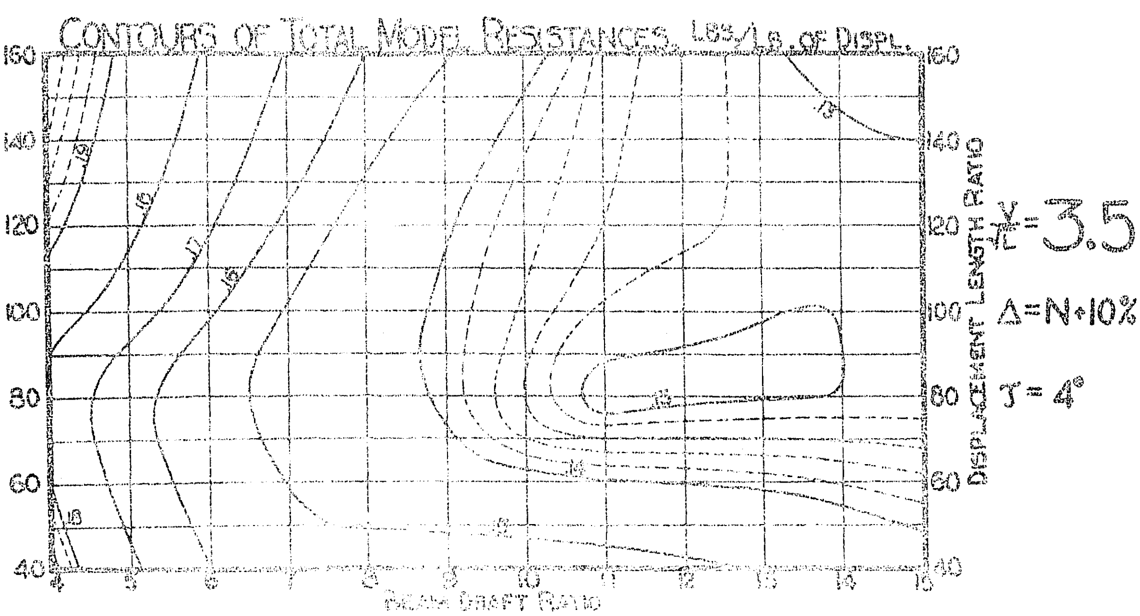

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.0$
Δ = N+10%
ɣ = 0°

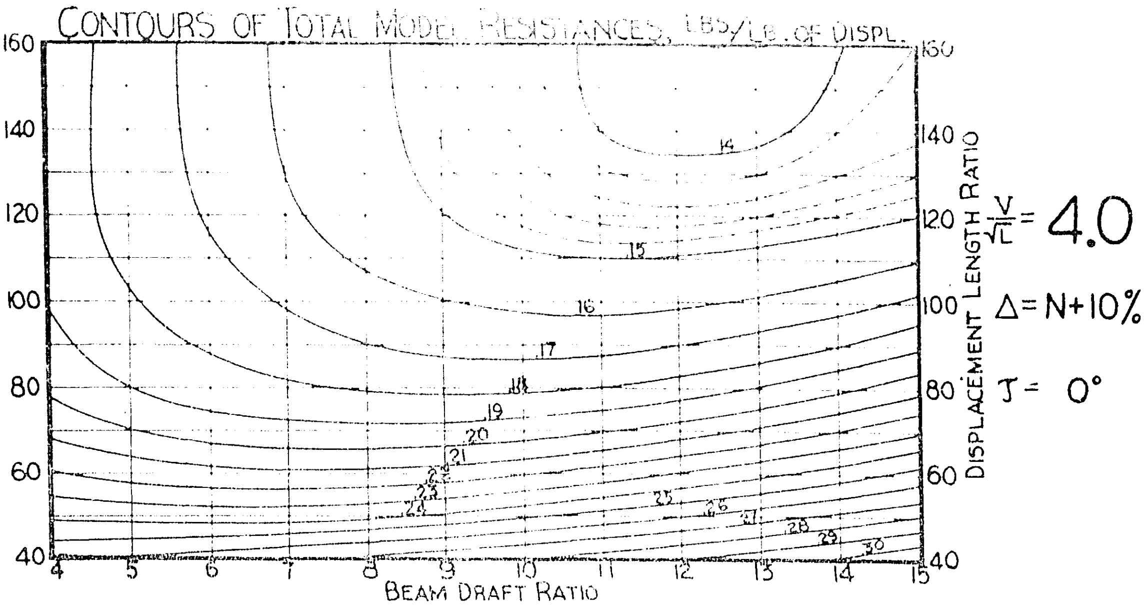

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.0$
Δ = N+10%
ɣ = 2°

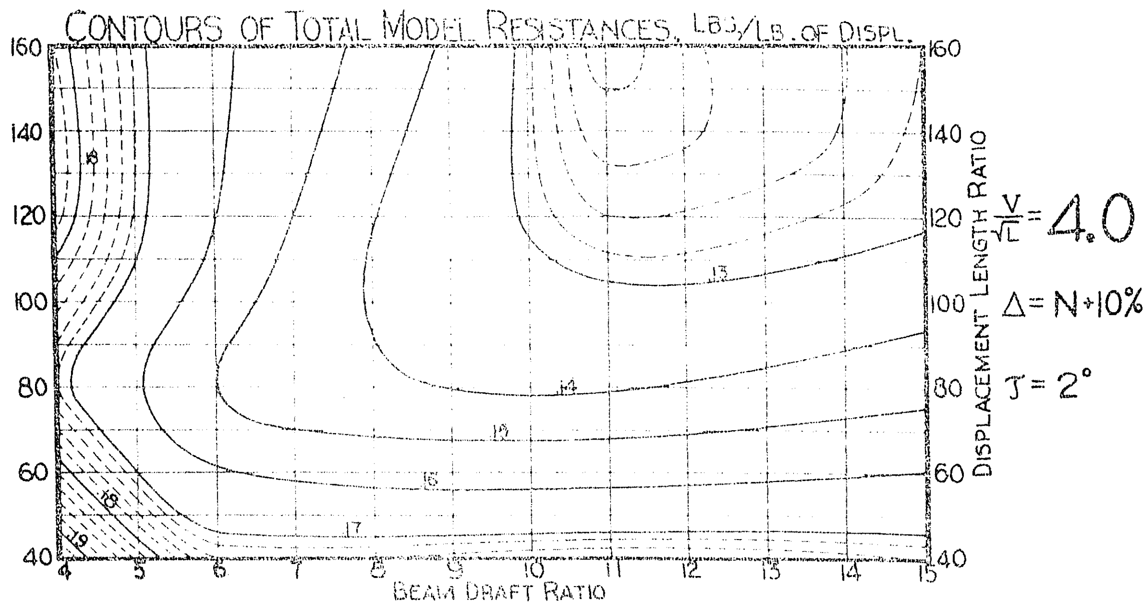

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.0$
Δ = N+10%
ɣ = 4°

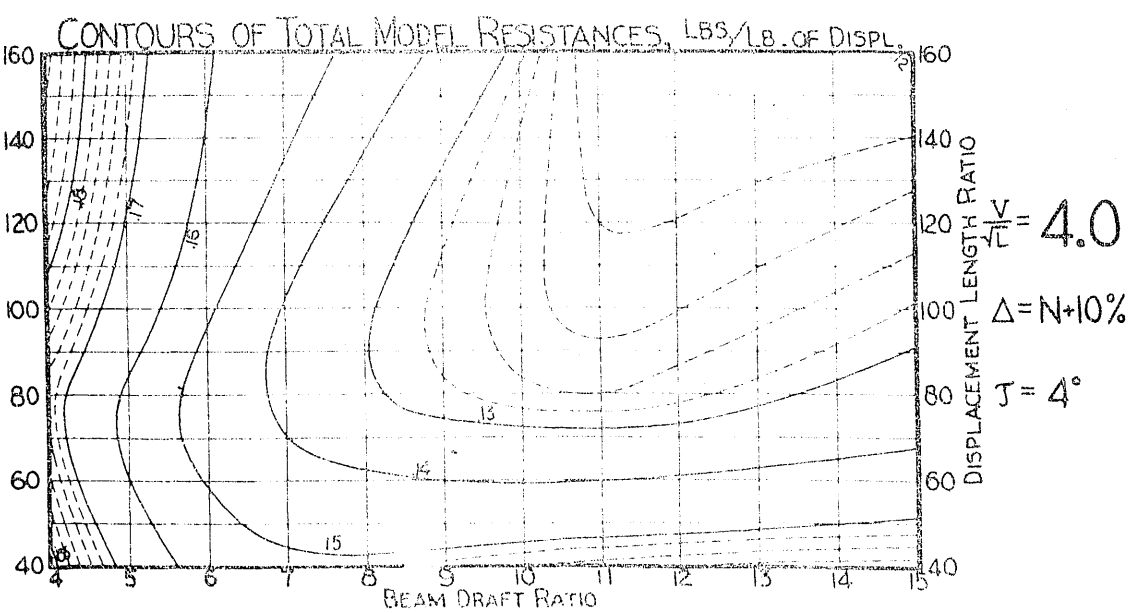

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.5$
Δ=N+10%
τ= 0°

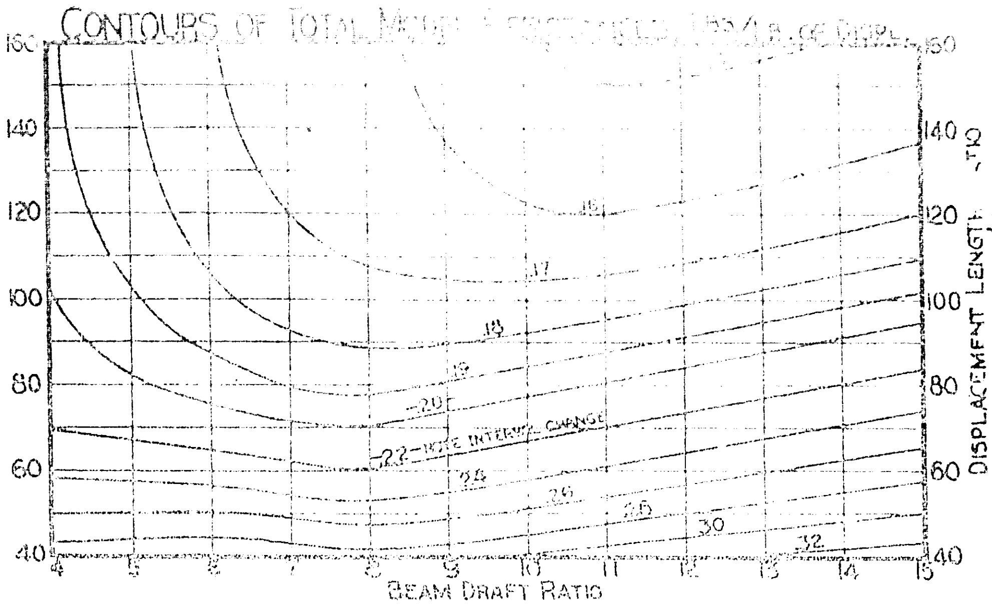

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.5$
Δ=N+10%
τ= 2°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.5$
Δ=N+10%
τ= 4°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 4.0$
$\Delta = N + 10\%$
$\tau = 0°$


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 4.0$
$\Delta = N + 10\%$
$\tau = 2°$

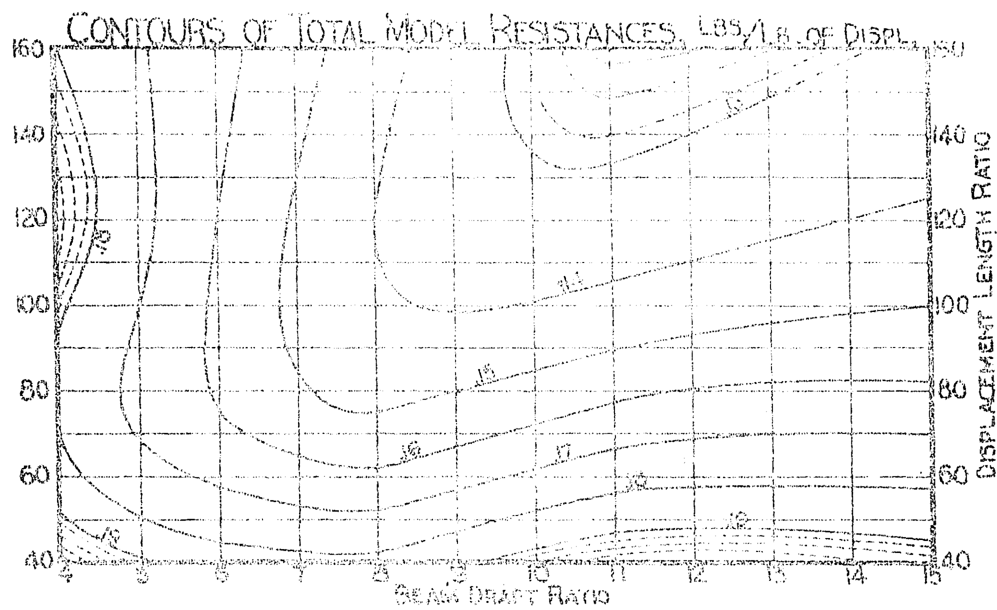

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 4.0$
$\Delta = N + 10\%$
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 4.5$

$\Delta = N+10\%$

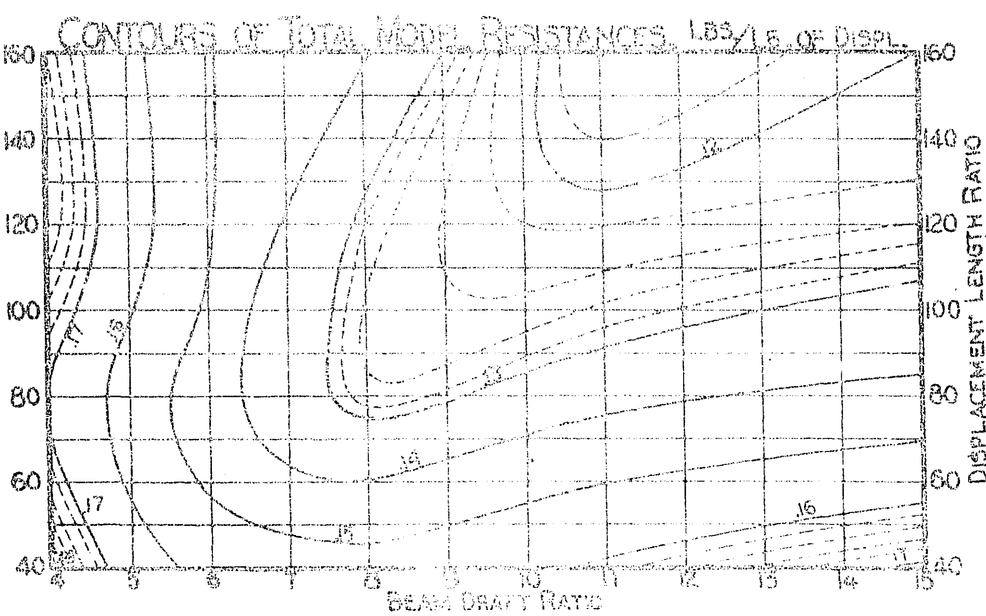
$\gamma = 0$



$\frac{V}{\sqrt{L}} = 4.5$

$\Delta = N+10\%$

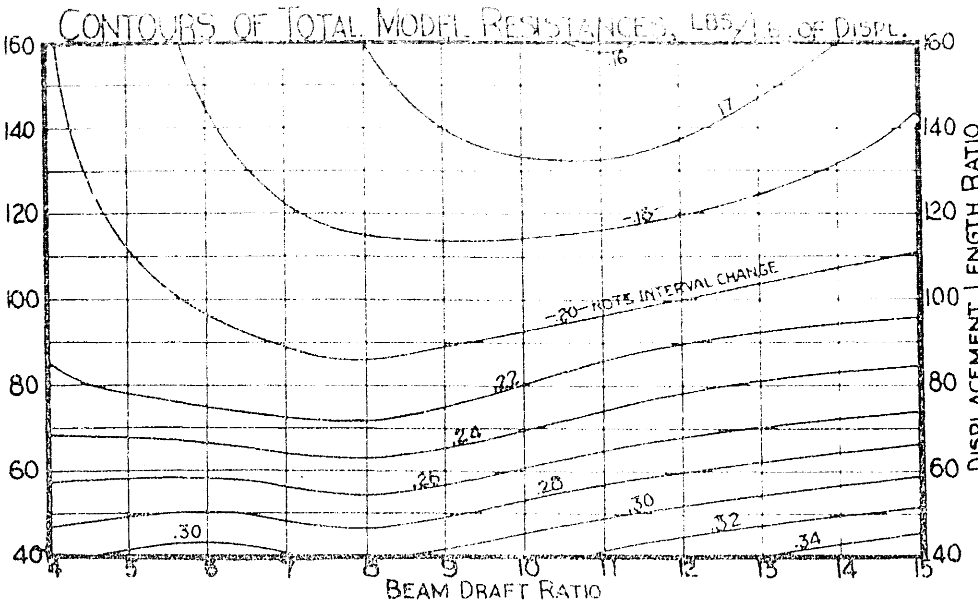
$\gamma = 2°$



$\frac{V}{\sqrt{L}} = 4.5$

$\Delta = N+10\%$

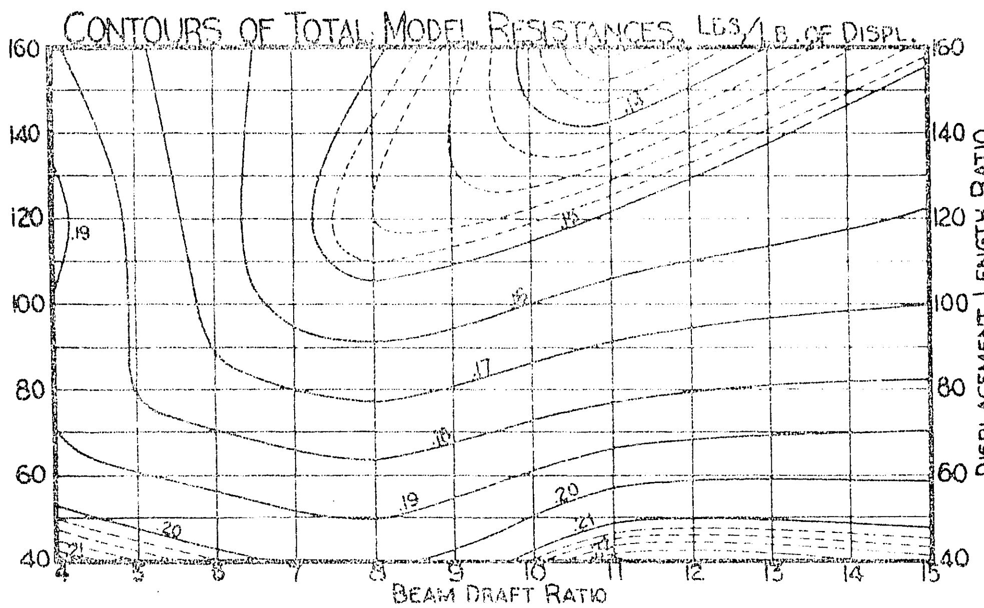
$\gamma = 4°$



$\frac{V}{\sqrt{L}} = 5.0$

$\Delta = N+10\%$

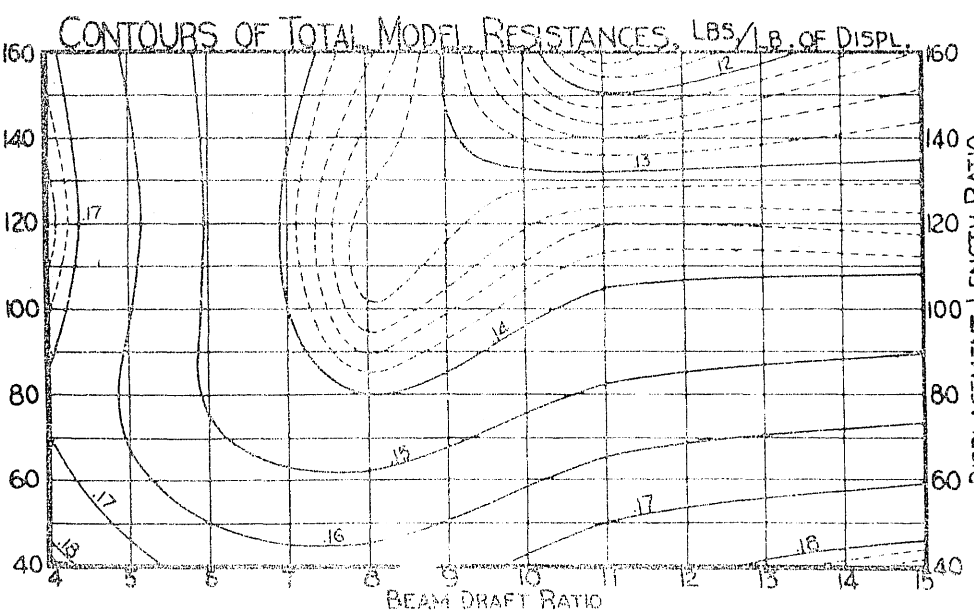
$\Upsilon = 0°$



$\frac{V}{\sqrt{L}} = 5.0$

$\Delta = N+10\%$

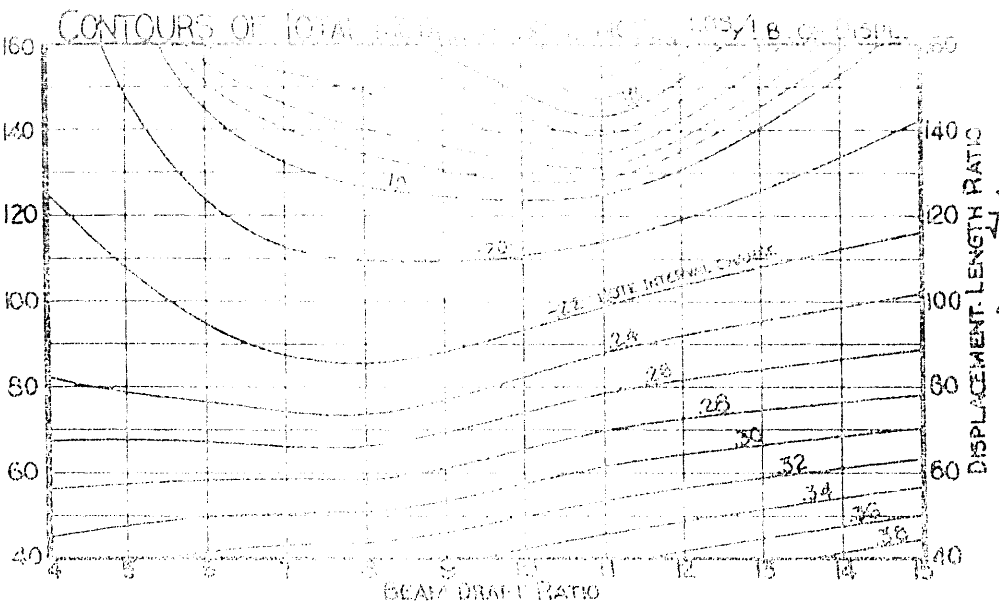
$\Upsilon = 2°$



$\frac{V}{\sqrt{L}} = 5.0$

$\Delta = N+10\%$

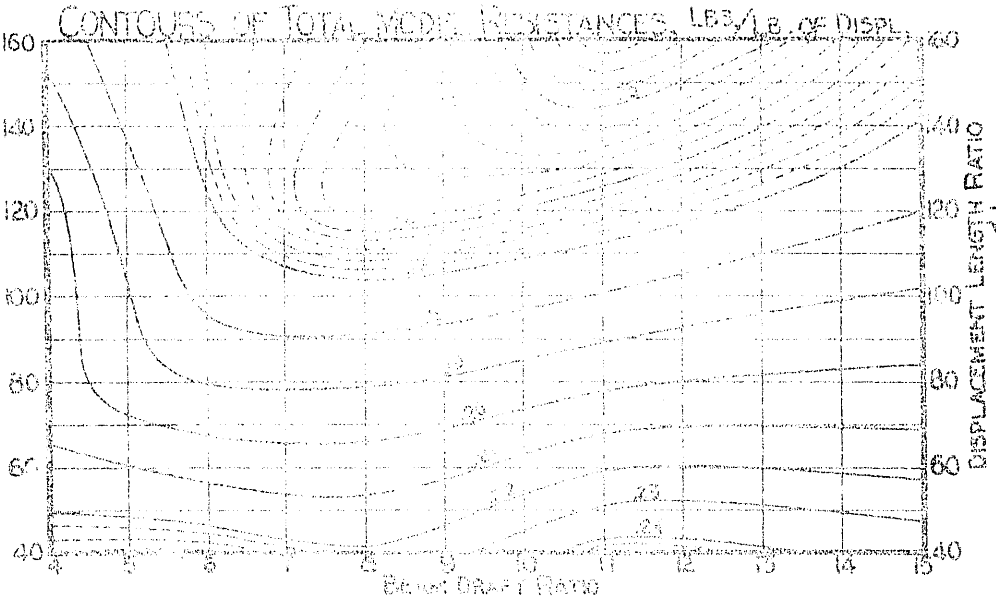
$\Upsilon = 4°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N + 10\%$

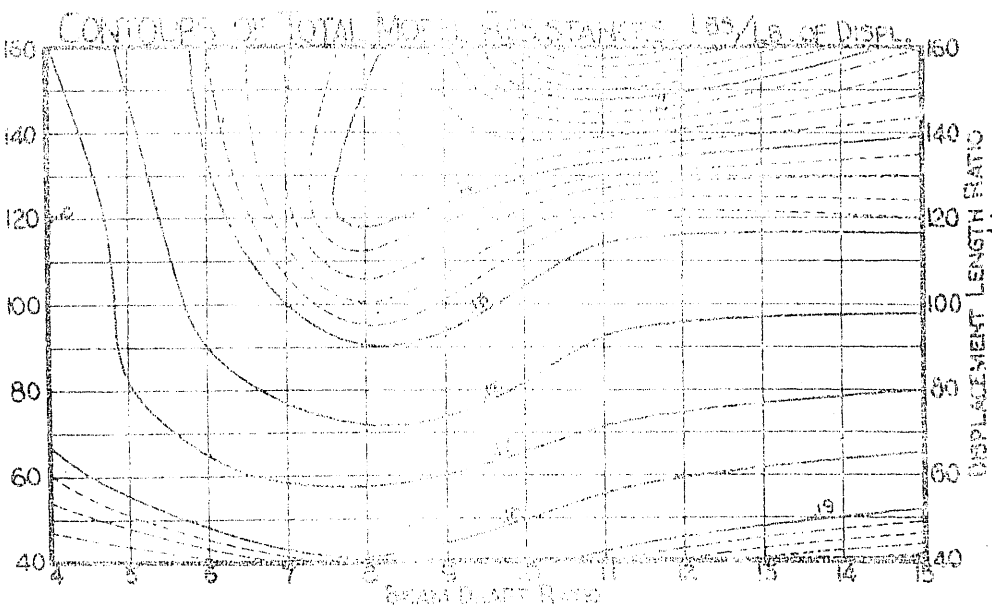
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N + 10\%$

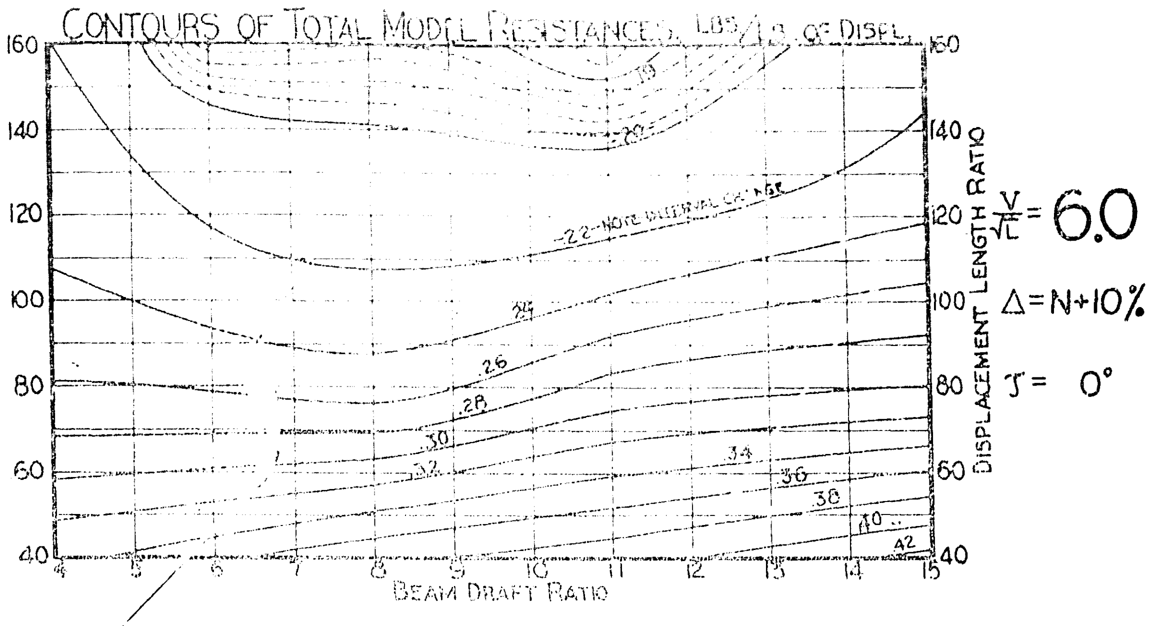
$\tau = 2°$

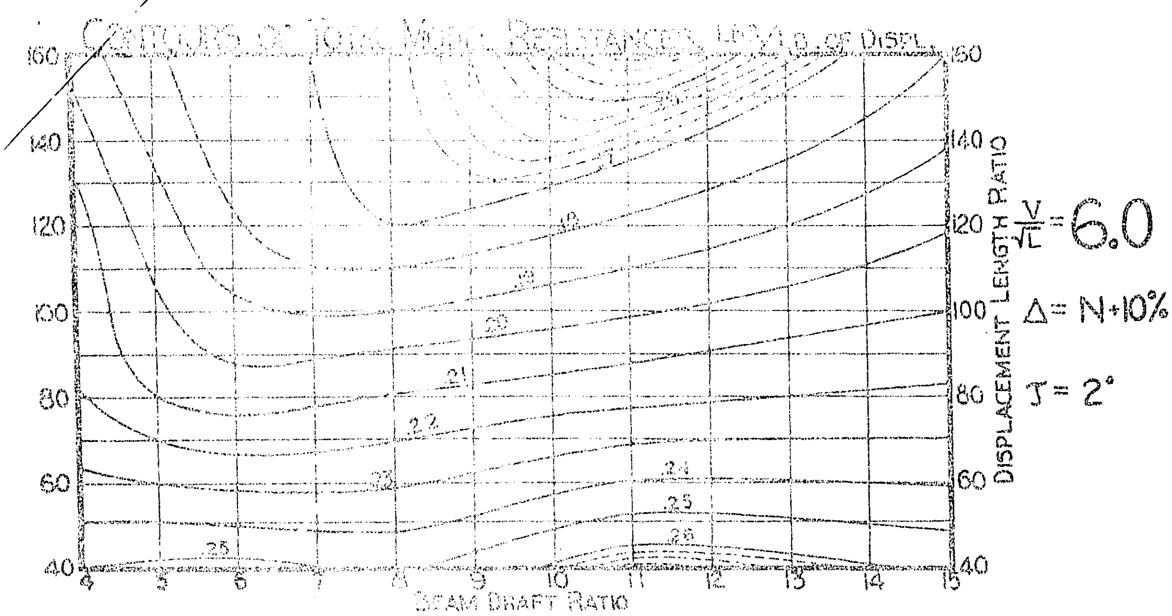


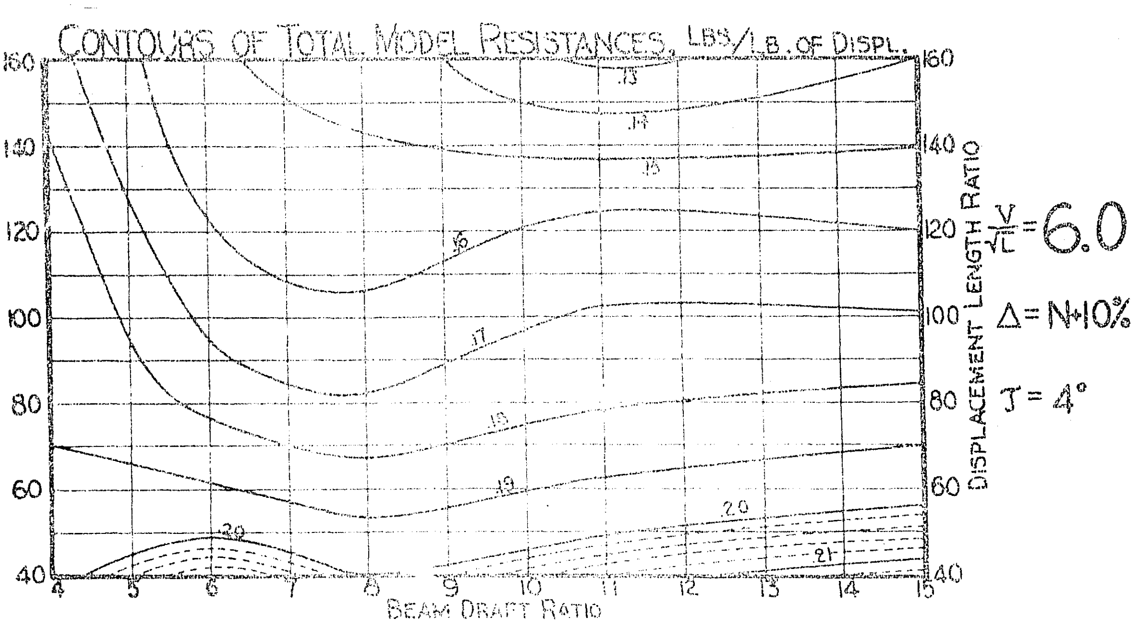
$\frac{V}{\sqrt{L}} = 5.5$

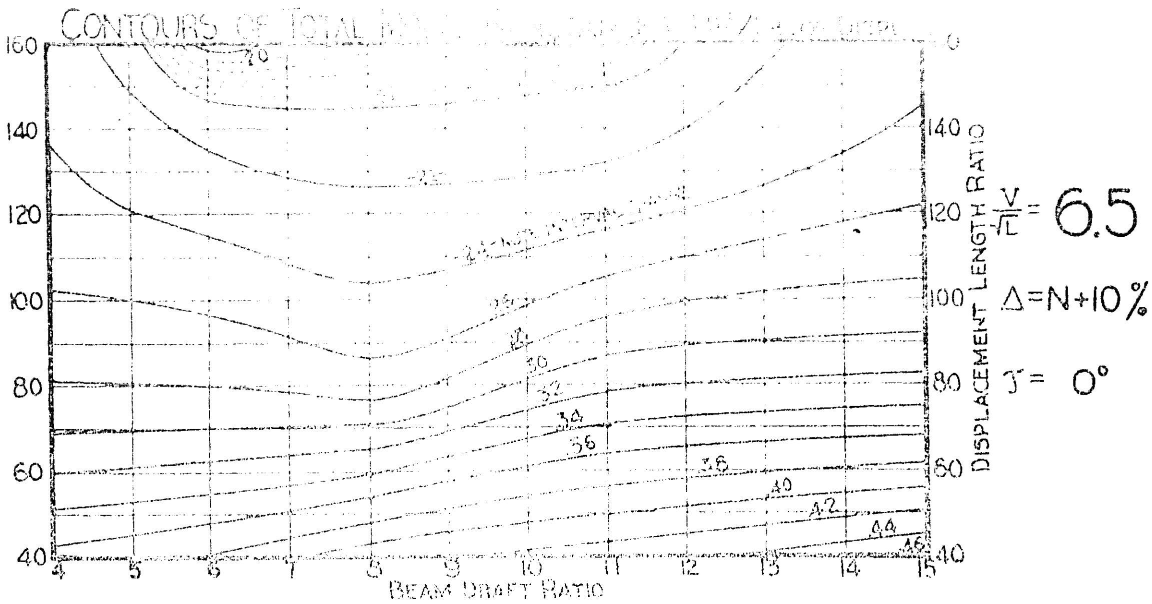
$\Delta = N + 10\%$

$\tau = 4°$

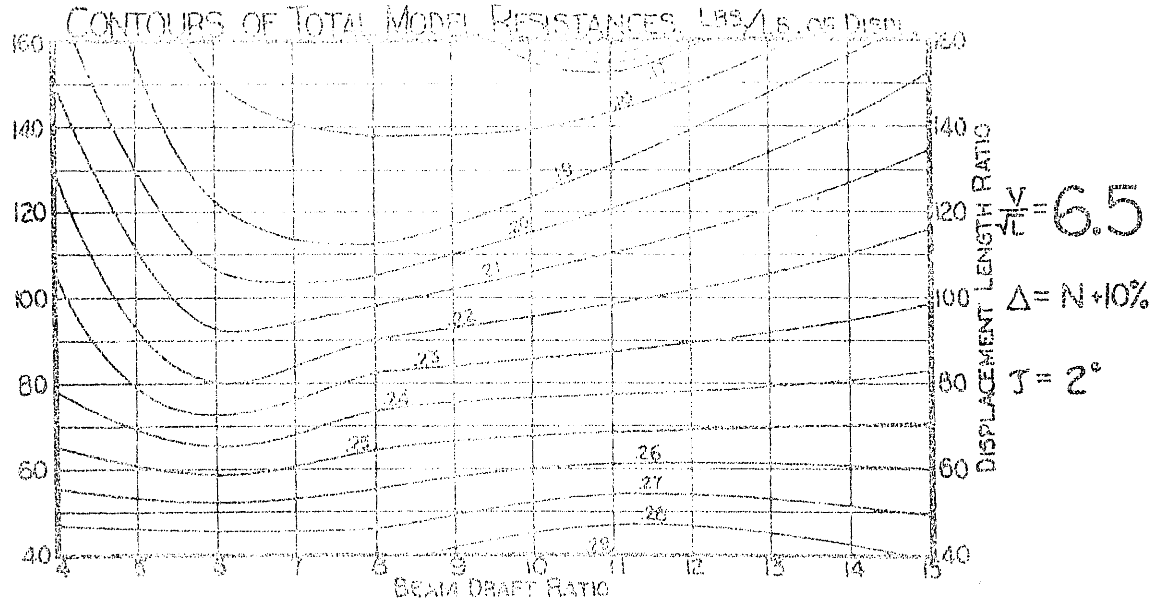

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
.22 - NOTE INTERVAL CHANGE
.24
.26
.28
.30
.32
.34
.36
.38
.40
.42
V/√L = 6.0
Δ = N+10%
τ = 0°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
.18
.19
.20
.21
.22
.23
.24
.25
.26
V/√L = 6.0
Δ = N+10%
τ = 2°

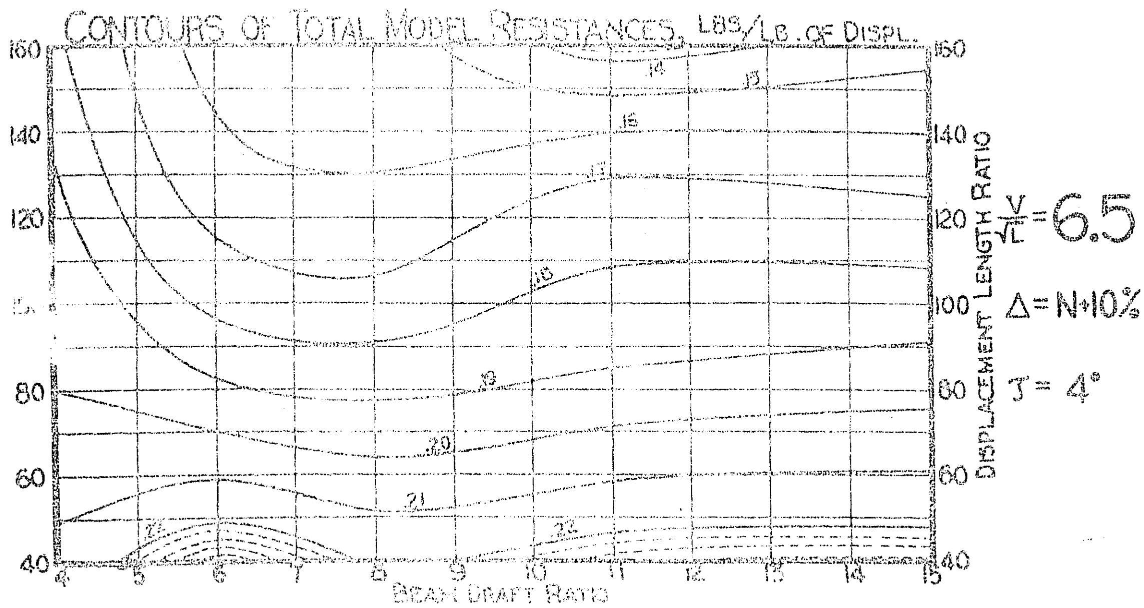

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
.13
.14
.15
.16
.17
.18
.19
.20
.21
V/√L = 6.0
Δ = N+10%
τ = 4°



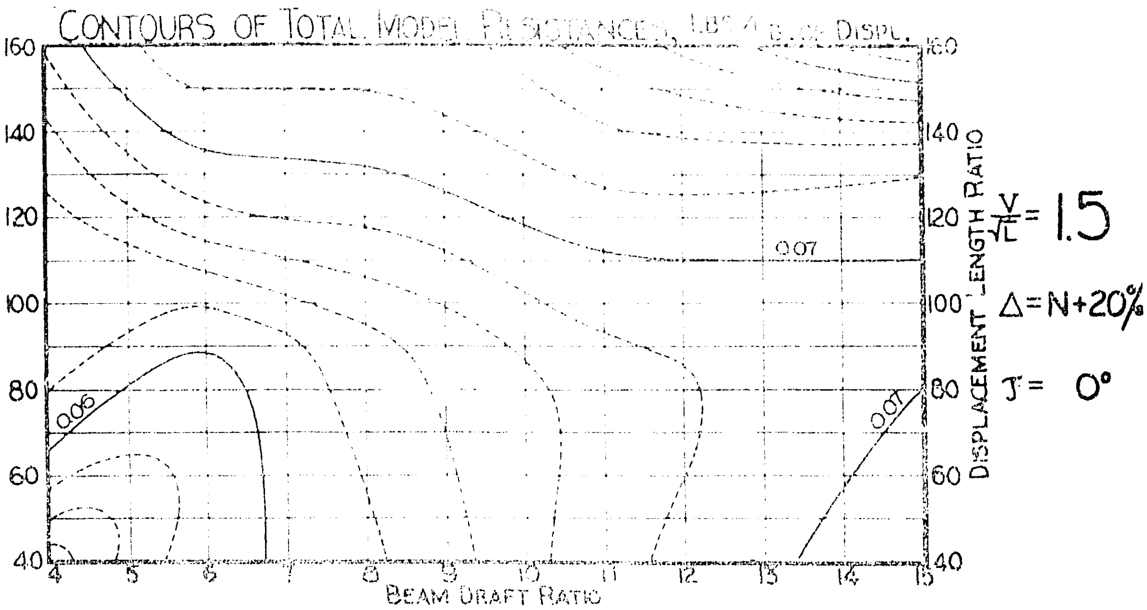
CONTOURS OF TOTAL
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 6.5$
$\Delta = N+10\%$
$\tau = 0°$

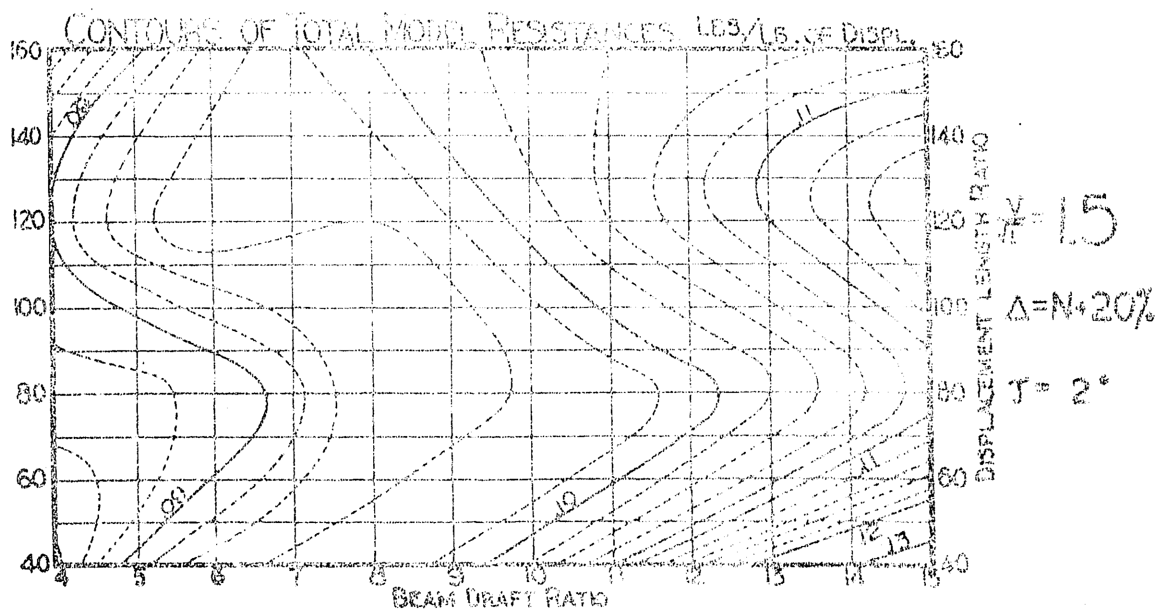


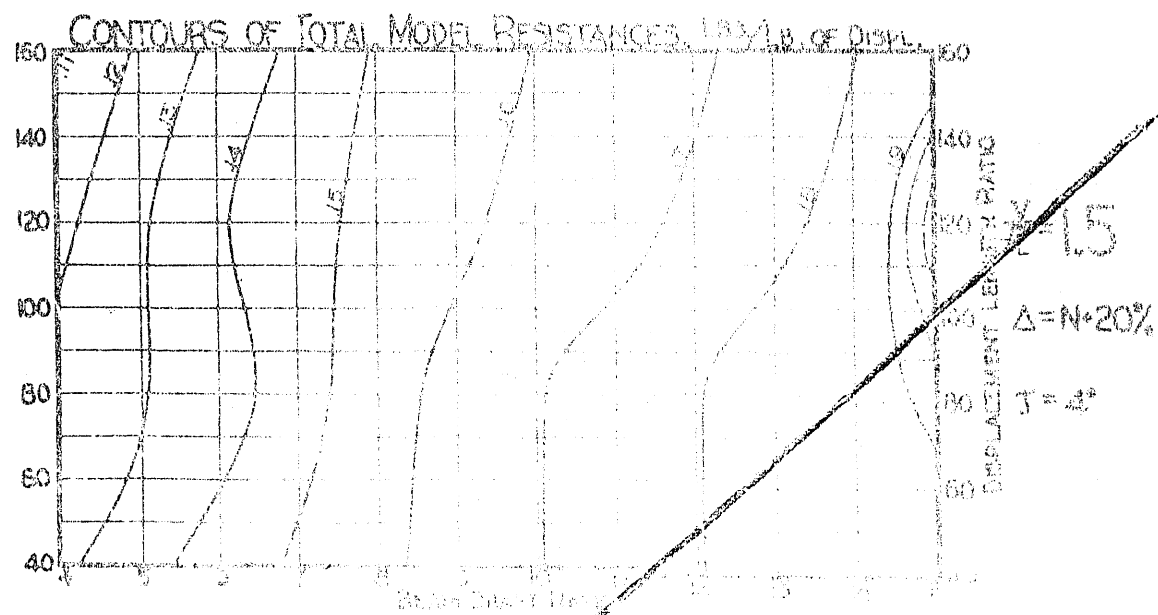
CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 6.5$
$\Delta = N+10\%$
$\tau = 2°$



CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 6.5$
$\Delta = N+10\%$
$\tau = 4°$


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
0.06
0.07
0.07
V/√L = 1.5
Δ=N+20%
τ = 0°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
.08
.11
.10
.11
.12
.13
V/√L = 1.5
Δ=N+20%
τ = 2°

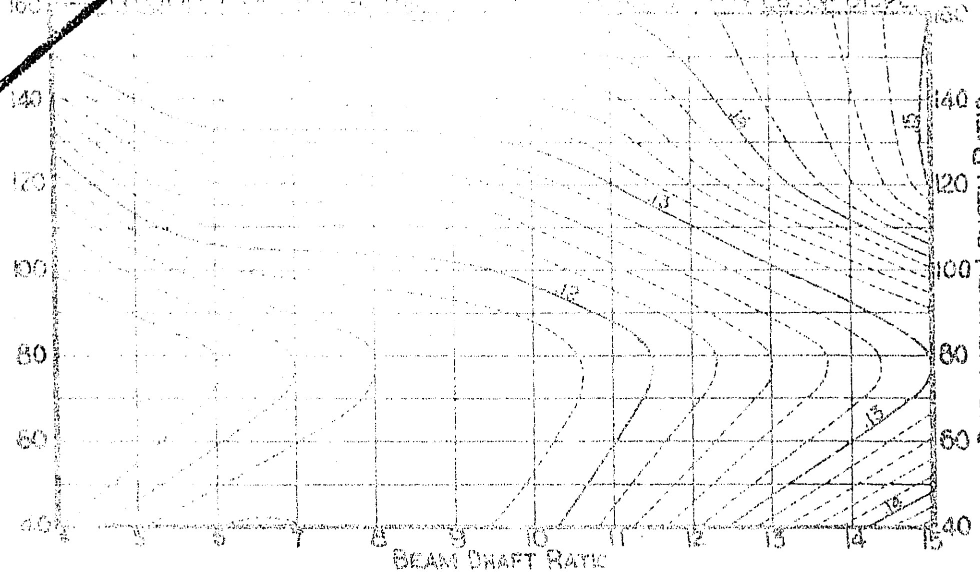

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
V/√L = 1.5
Δ=N+20%
τ = 4°

$\frac{V}{\sqrt{L}} = 2.0$

$\Delta = N + 20\%$

$J = 0°$

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.

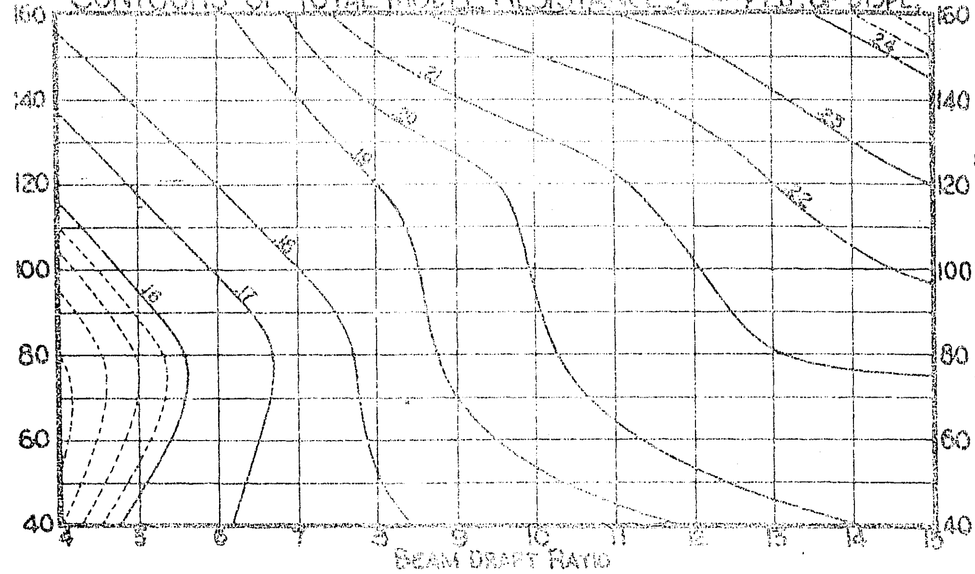


$\frac{V}{\sqrt{L}} = 2.0$

$\Delta = N + 20\%$

$J = 2°$

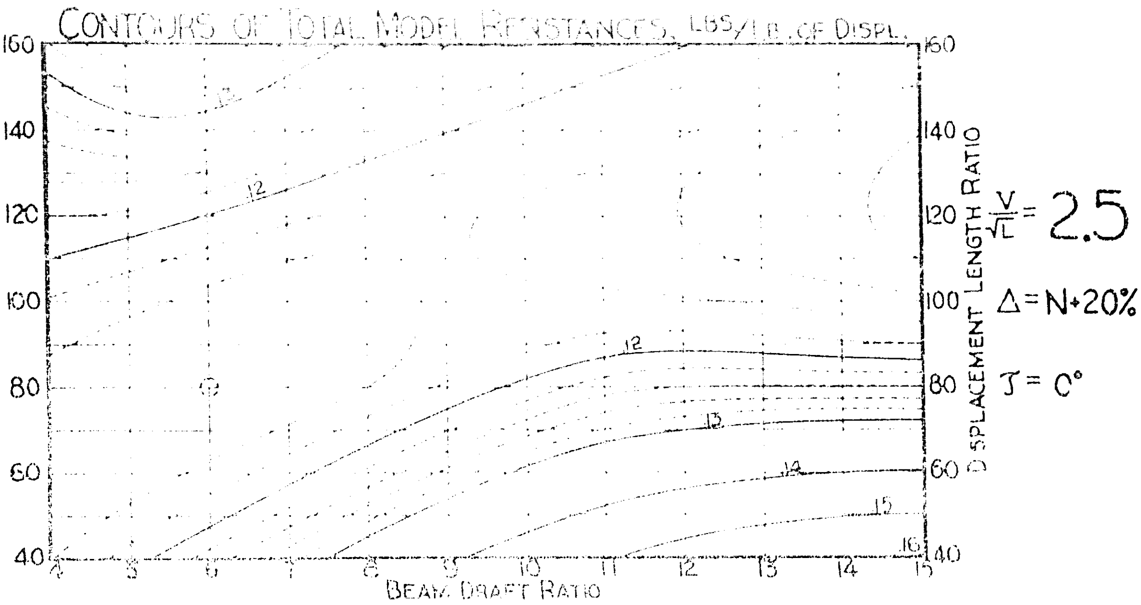
CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.

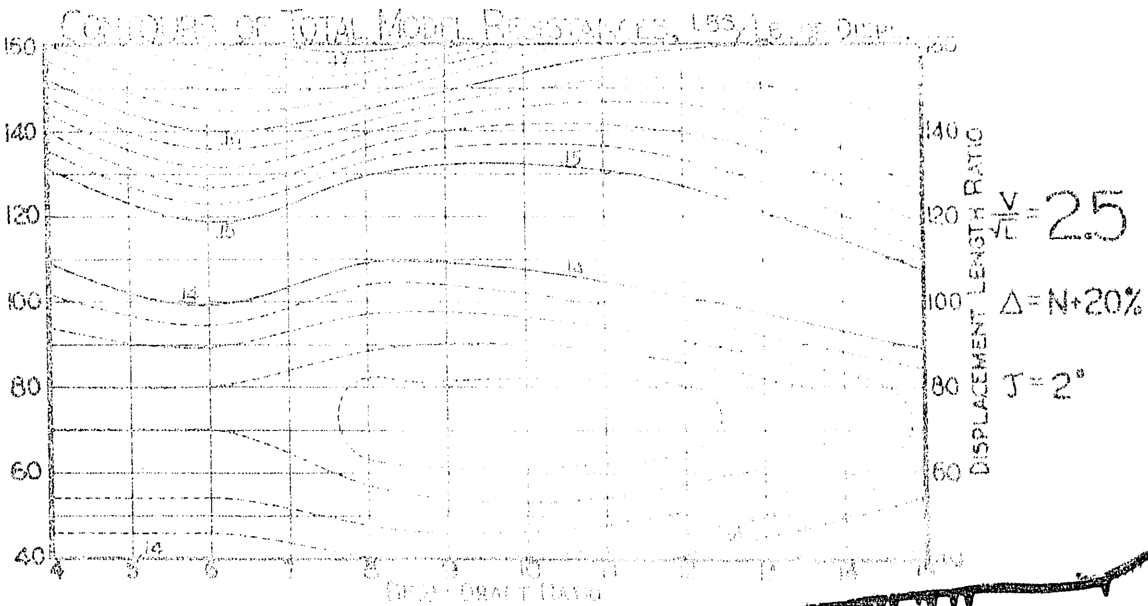


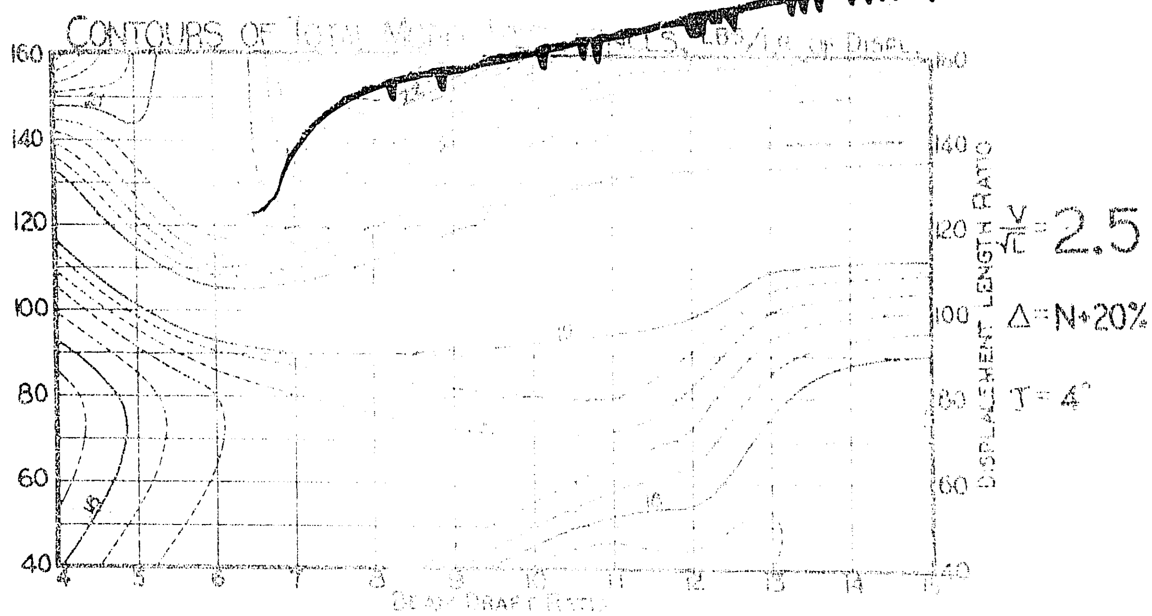
$\frac{V}{\sqrt{L}} = 2.0$

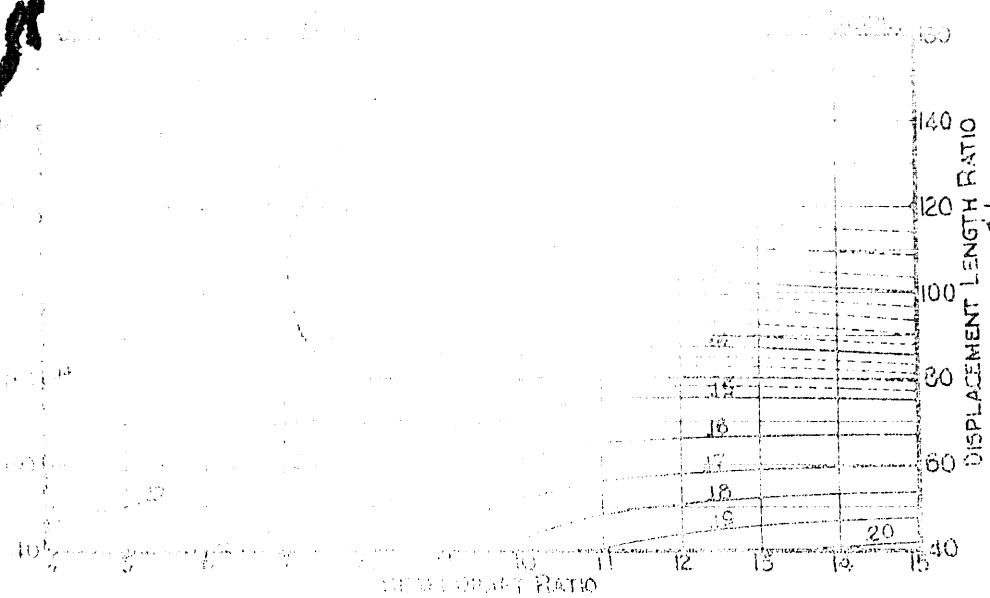
$\Delta = N + 20\%$

$J = 4°$


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 2.5$
$\Delta = N + 20\%$
$\tau = 0°$


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 2.5$
$\Delta = N + 20\%$
$\tau = 2°$


CONTOURS OF TOTAL MODEL
LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 2.5$
$\Delta = N + 20\%$
$\tau = 4°$

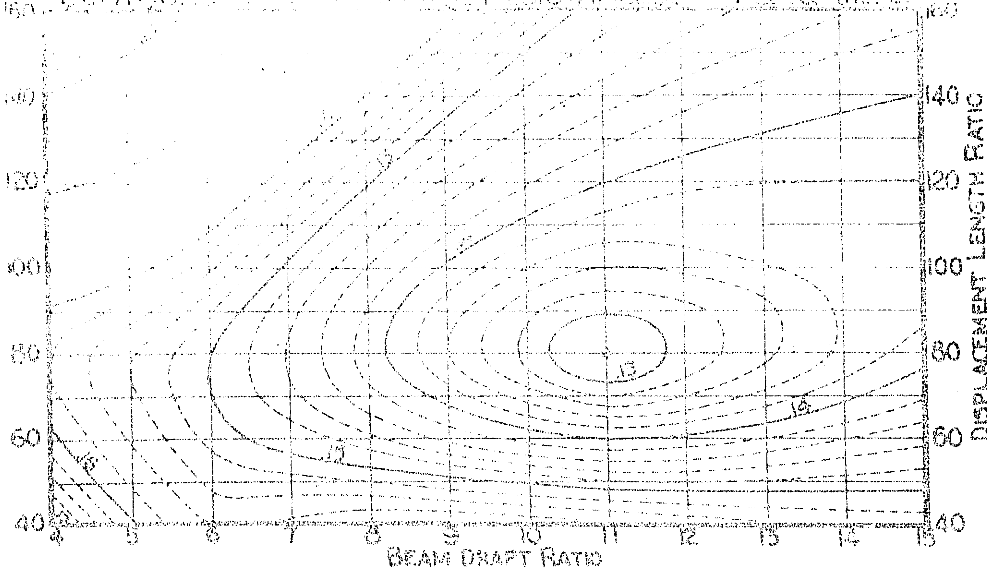


$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 20\%$

$\gamma = 0°$

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.

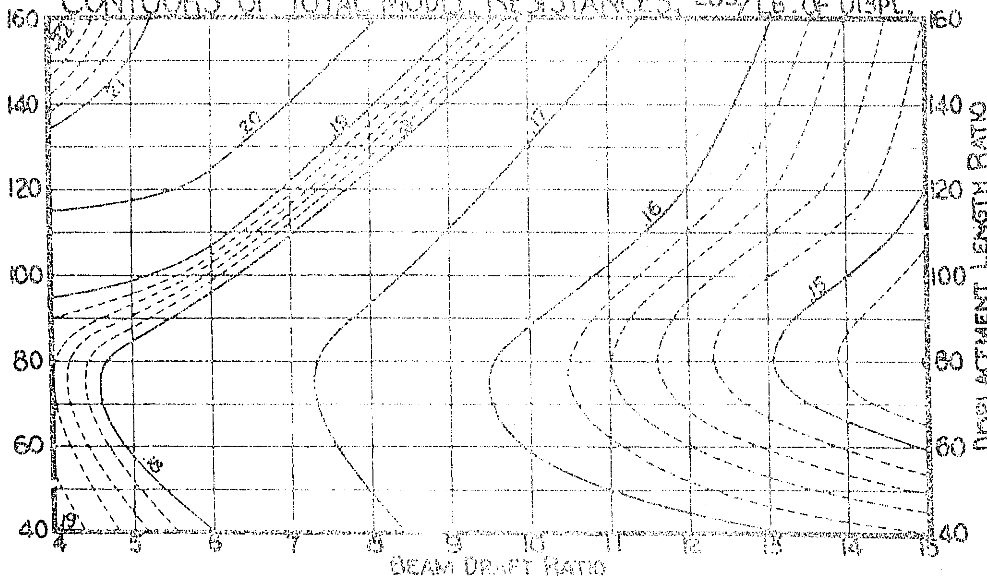


$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 20\%$

$\gamma = 2°$

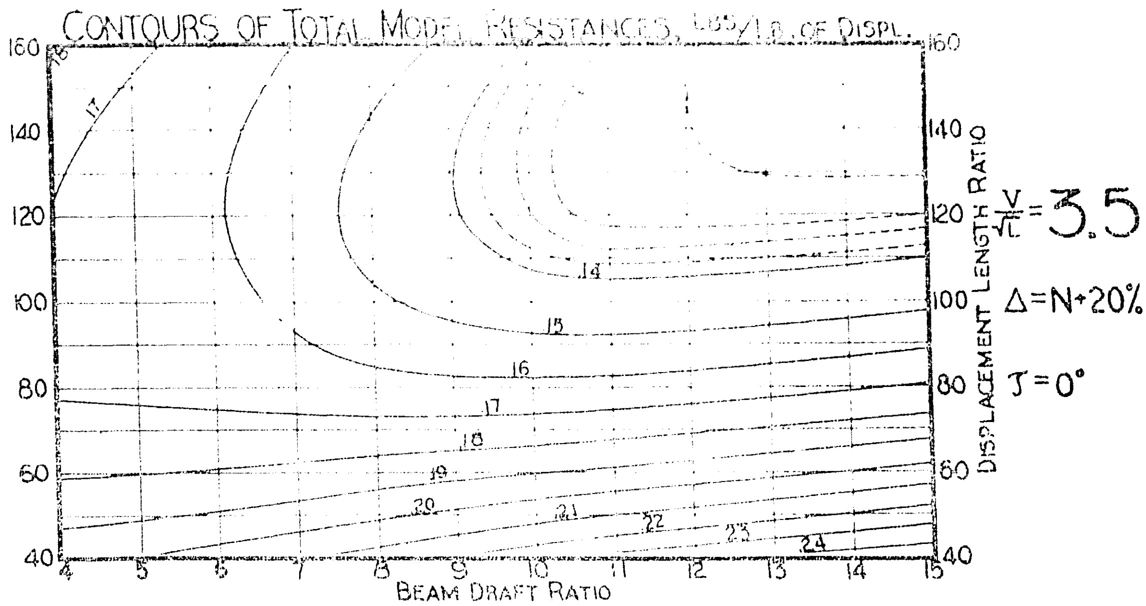
CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.

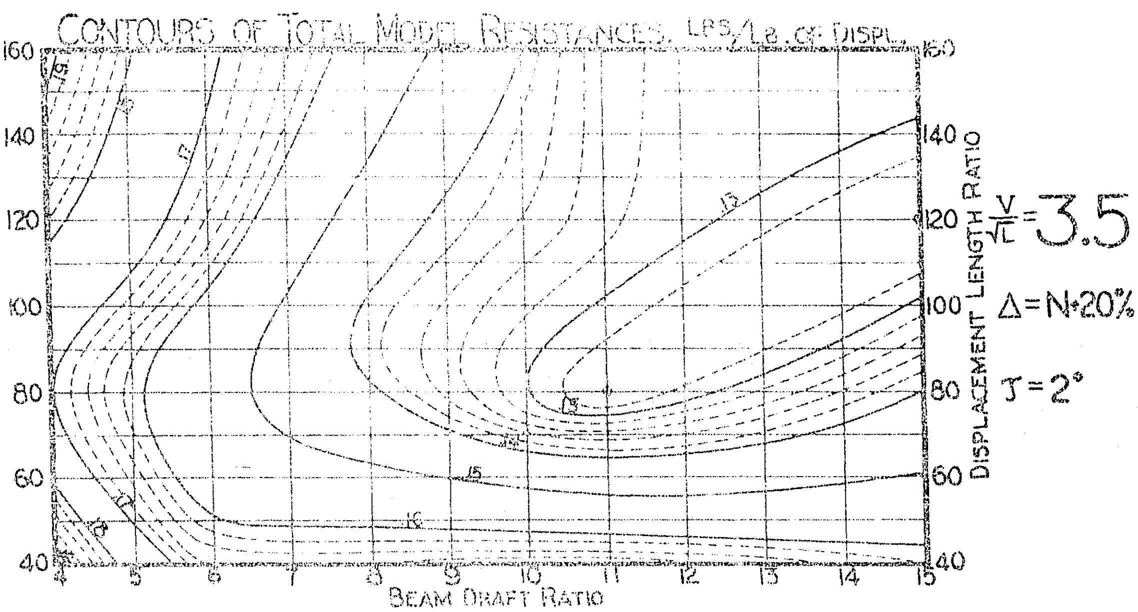


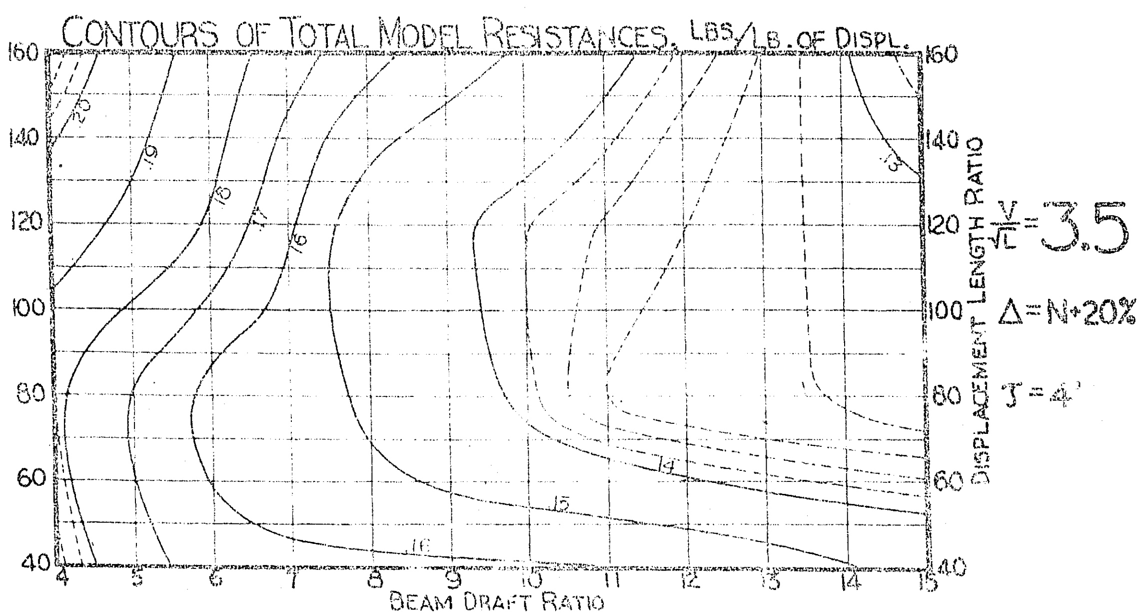
$\frac{V}{\sqrt{L}} = 3.0$

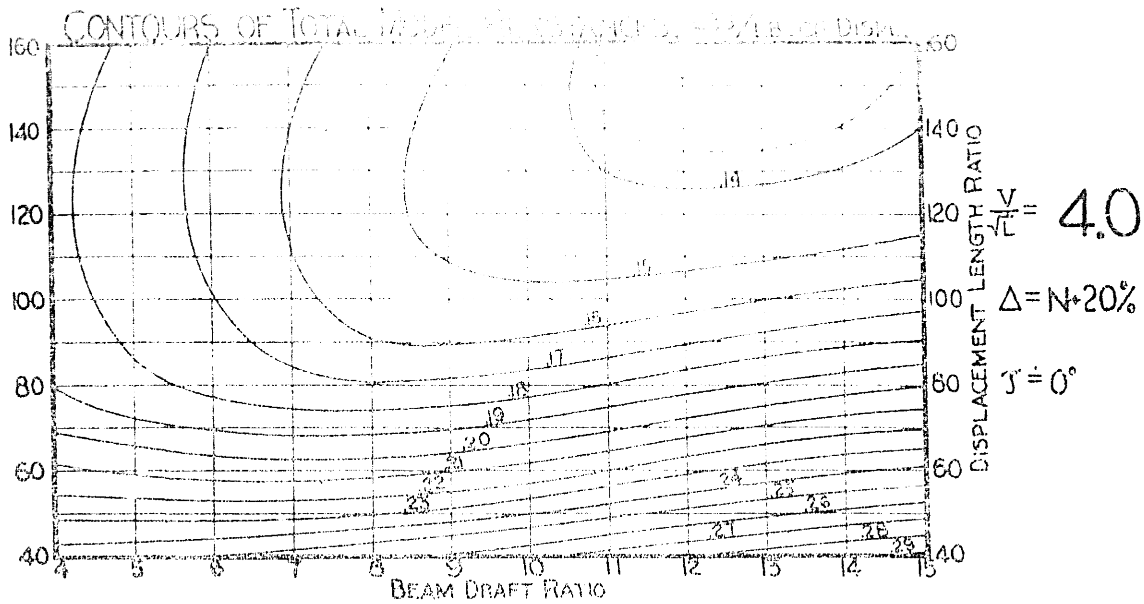
$\Delta = N$. %

$\gamma = 4°$

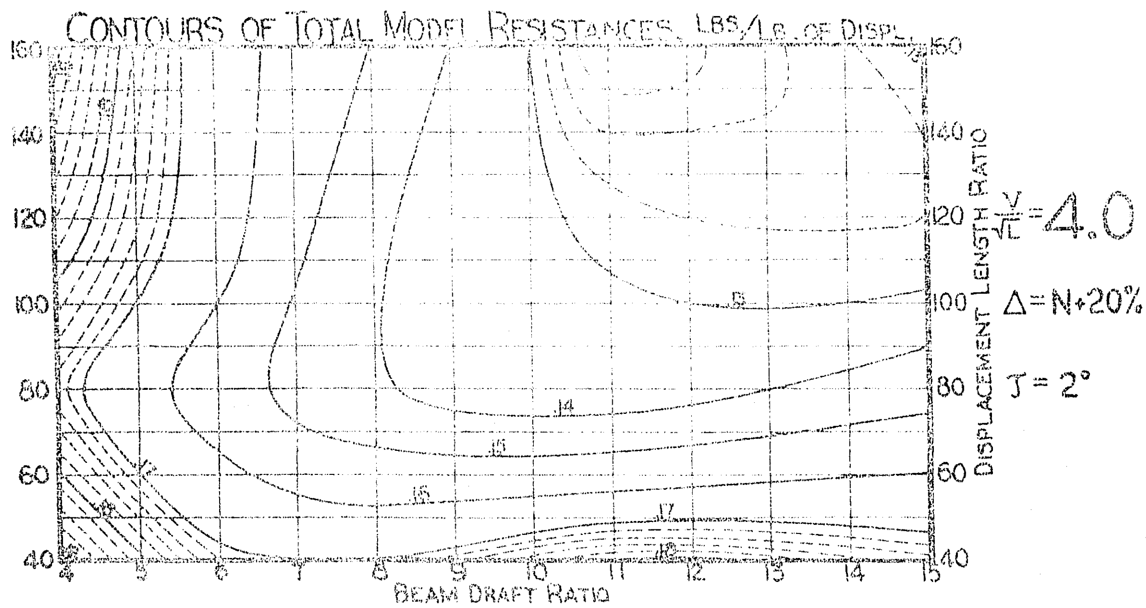

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.5$
Δ=N+20%
τ=0°
14
15
16
17
18
19
20
21
22
23
24


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.5$
Δ=N+20%
τ=2°
13
15
16
17
18

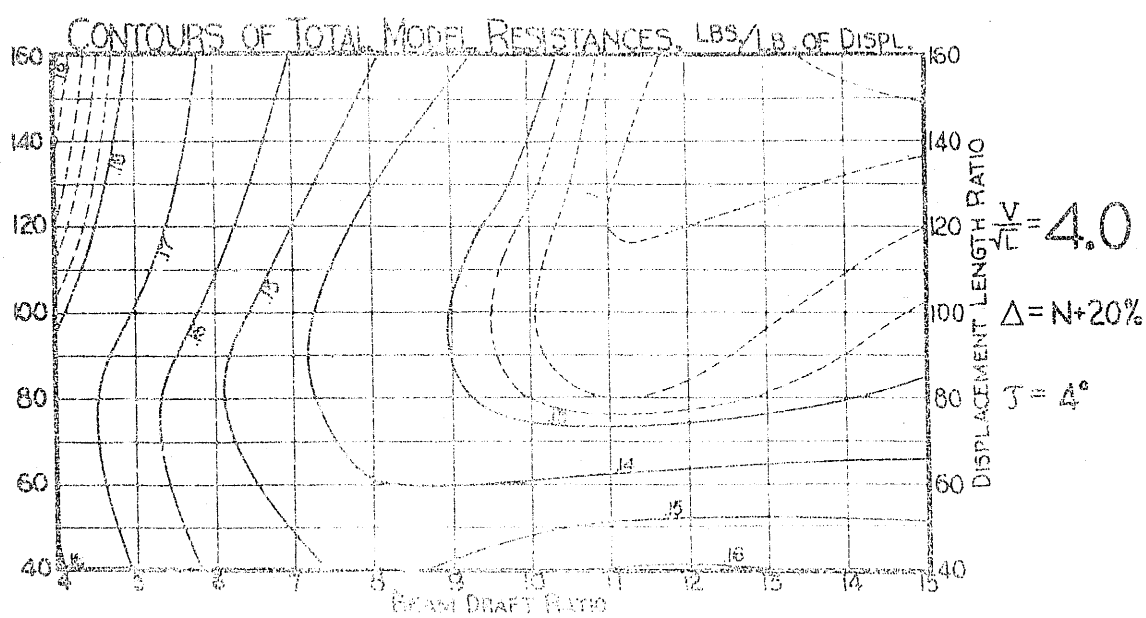

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 3.5$
Δ=N+20%
τ=4°
13
14
15
16
17
18
19
20



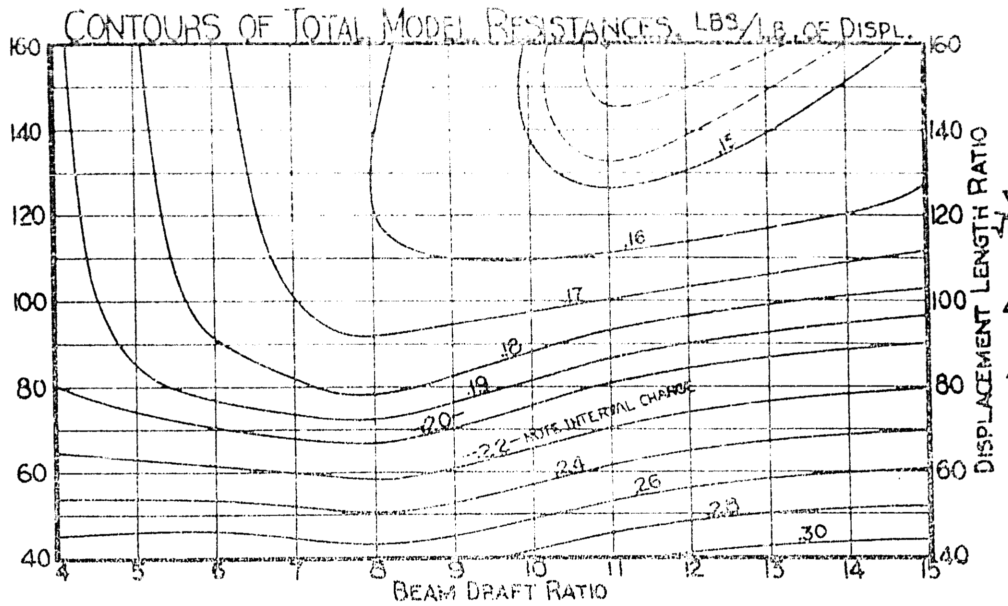
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 4.0$
$\Delta = N + 20\%$
$\tau = 0°$



CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 4.0$
$\Delta = N + 20\%$
$\tau = 2°$



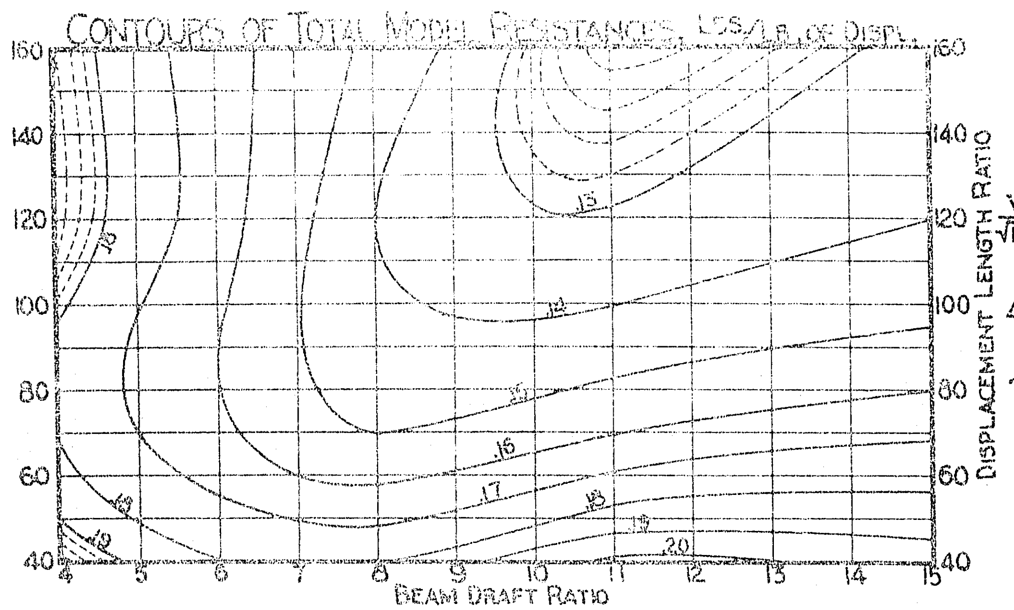
CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 4.0$
$\Delta = N + 20\%$
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 4.5$

$\Delta = N + 20\%$

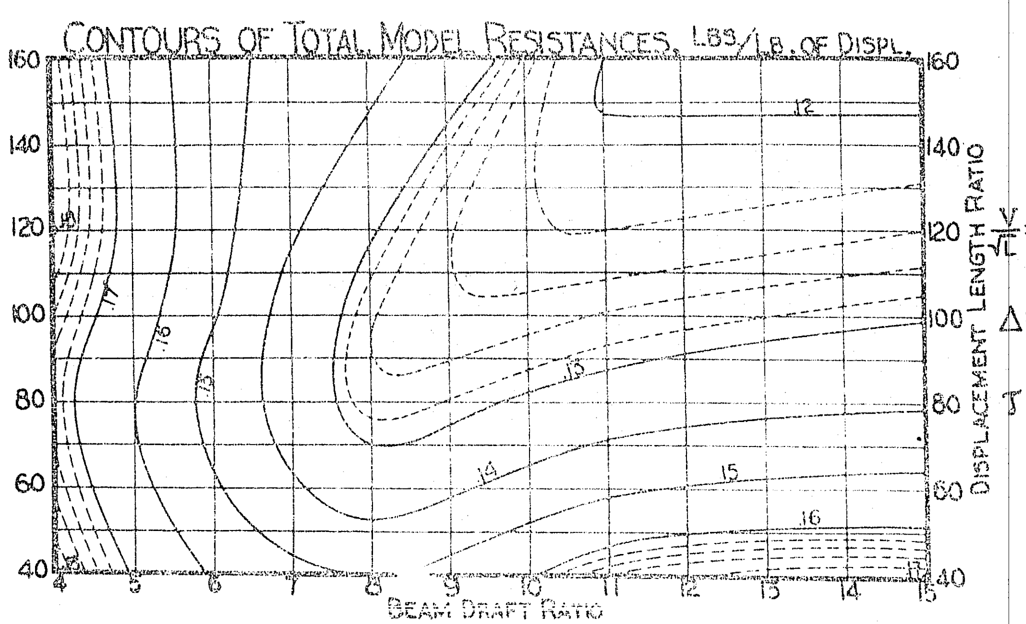
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 4.5$

$\Delta = N + 20\%$

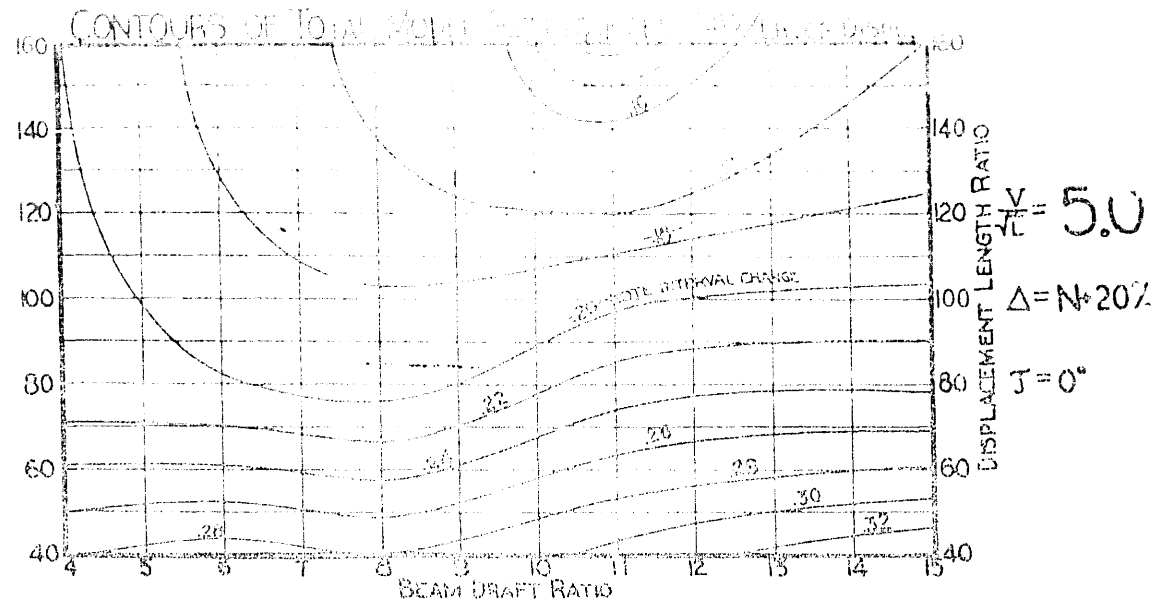
$\tau = 2°$

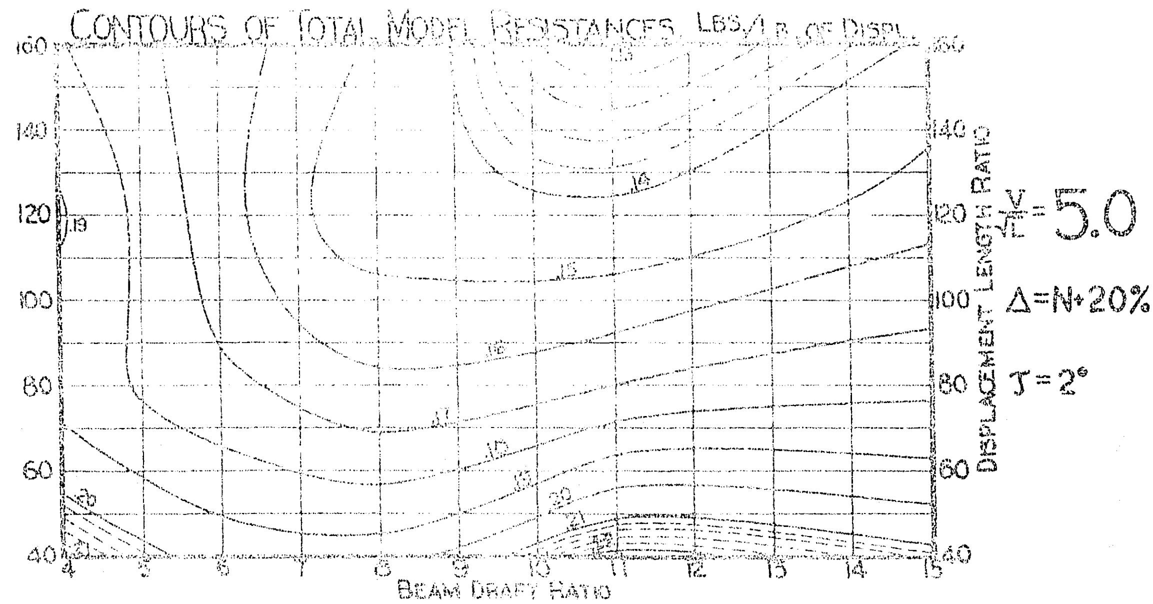


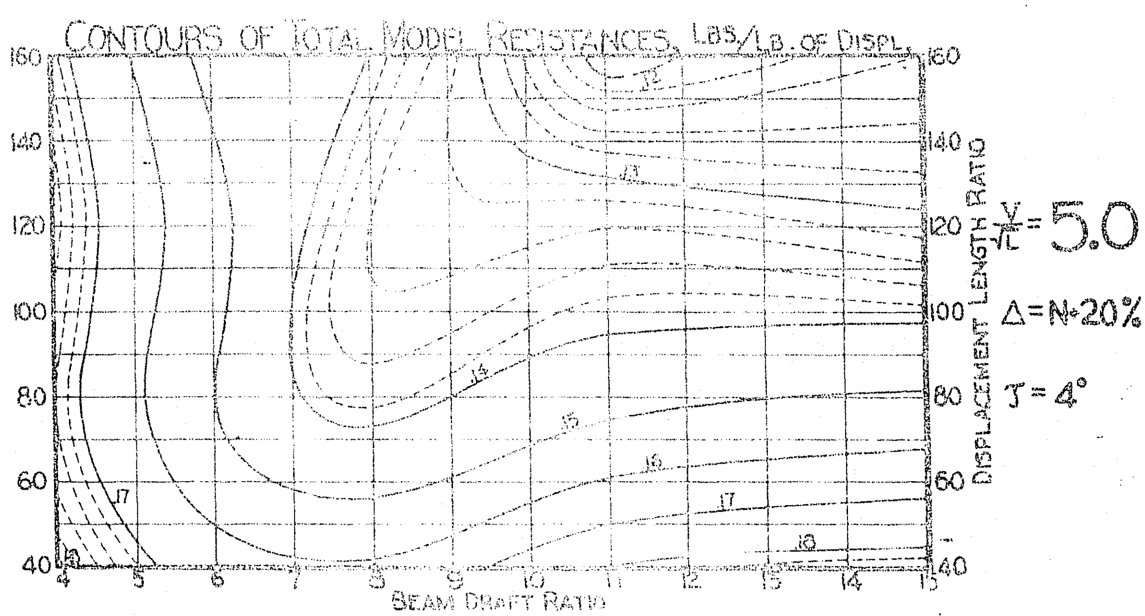
$\frac{V}{\sqrt{L}} = 4.5$

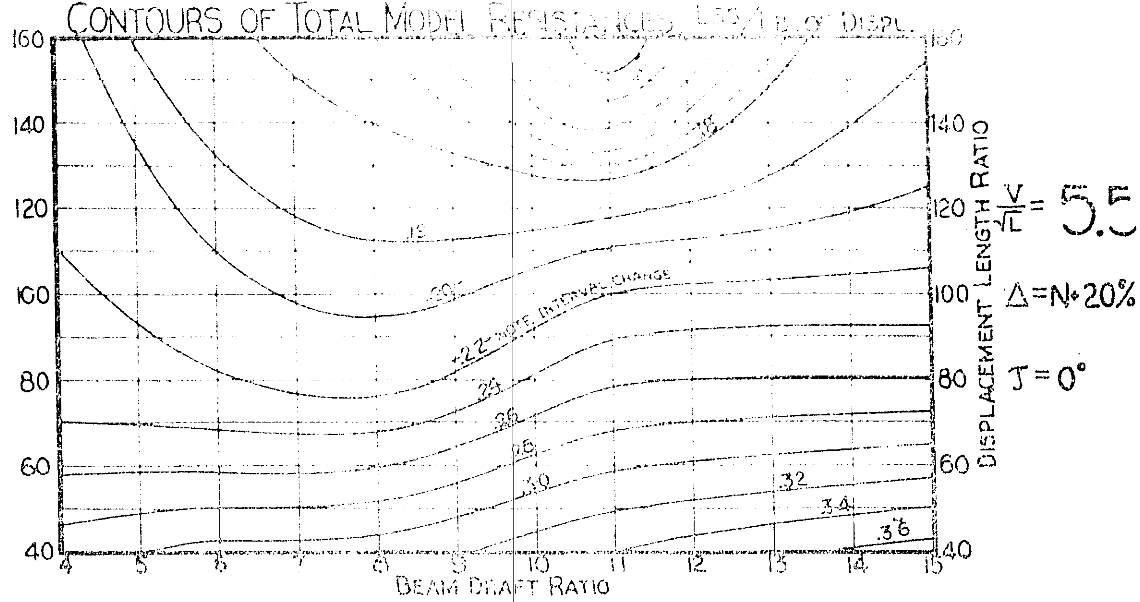
$\Delta = N + 20\%$

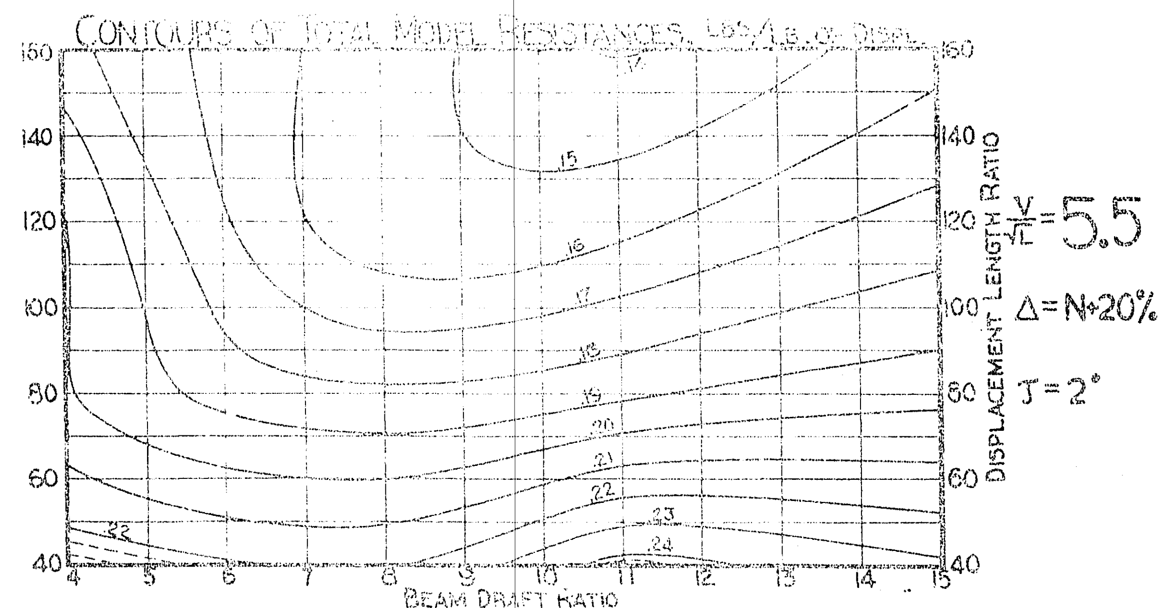
$\tau = 4°$

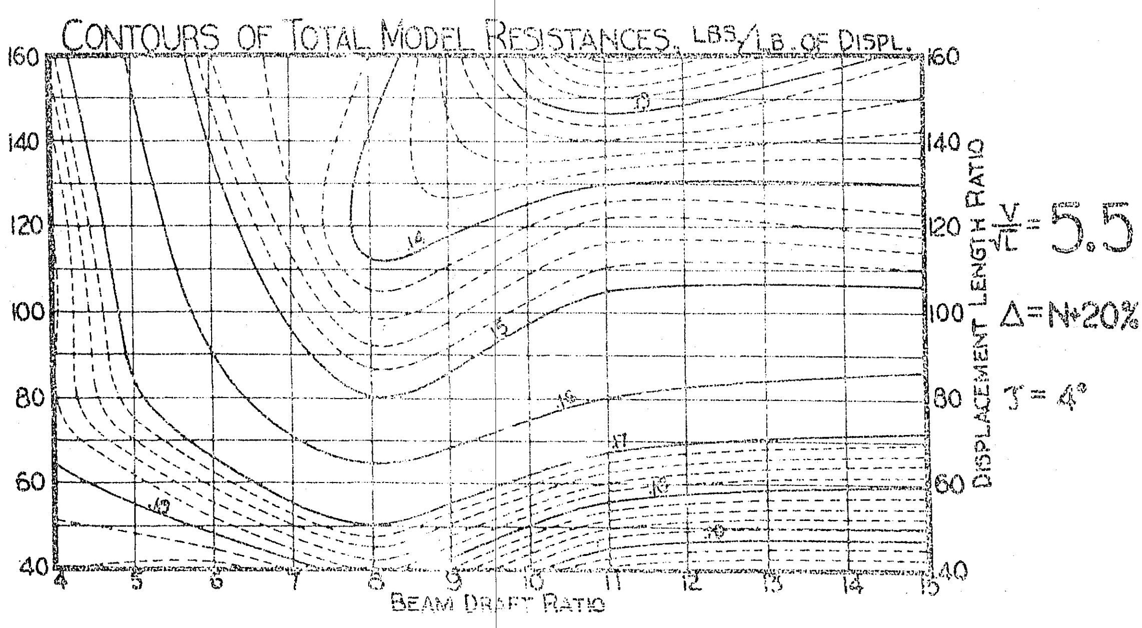

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
NOTE INTERVAL CHANGE
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 5.0$
$\Delta = N + 20\%$
$\tau = 0°$

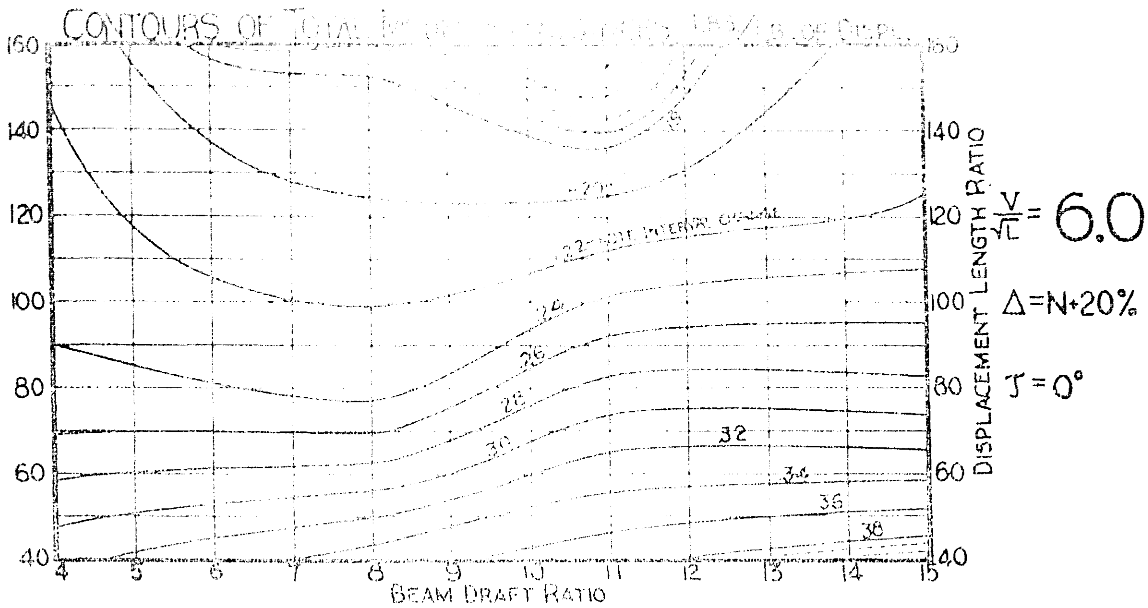

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 5.0$
$\Delta = N + 20\%$
$\tau = 2°$

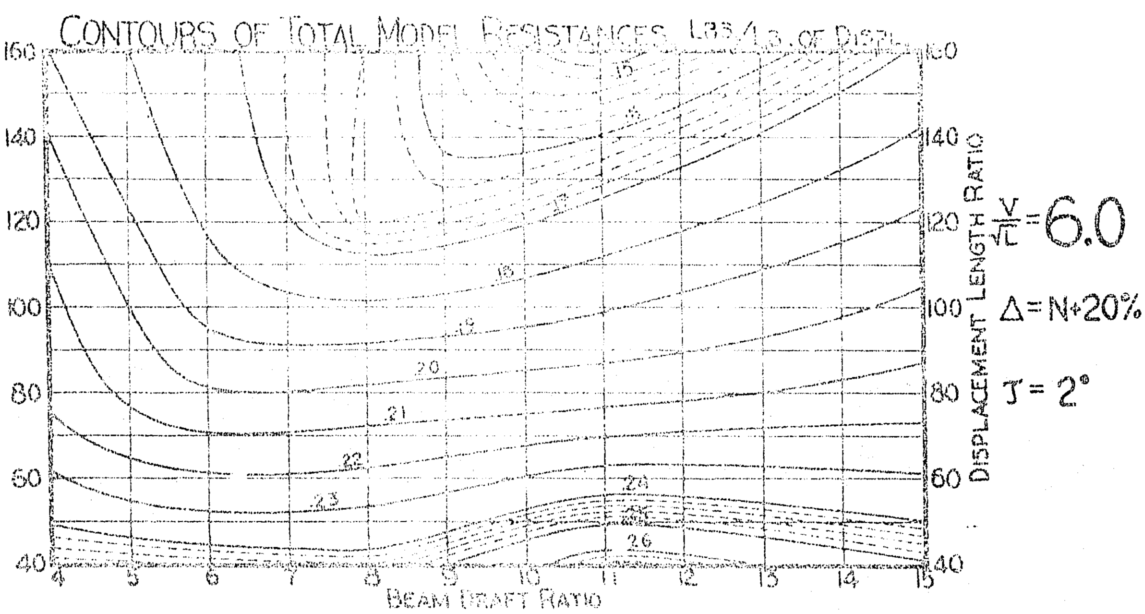

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 5.0$
$\Delta = N + 20\%$
$\tau = 4°$

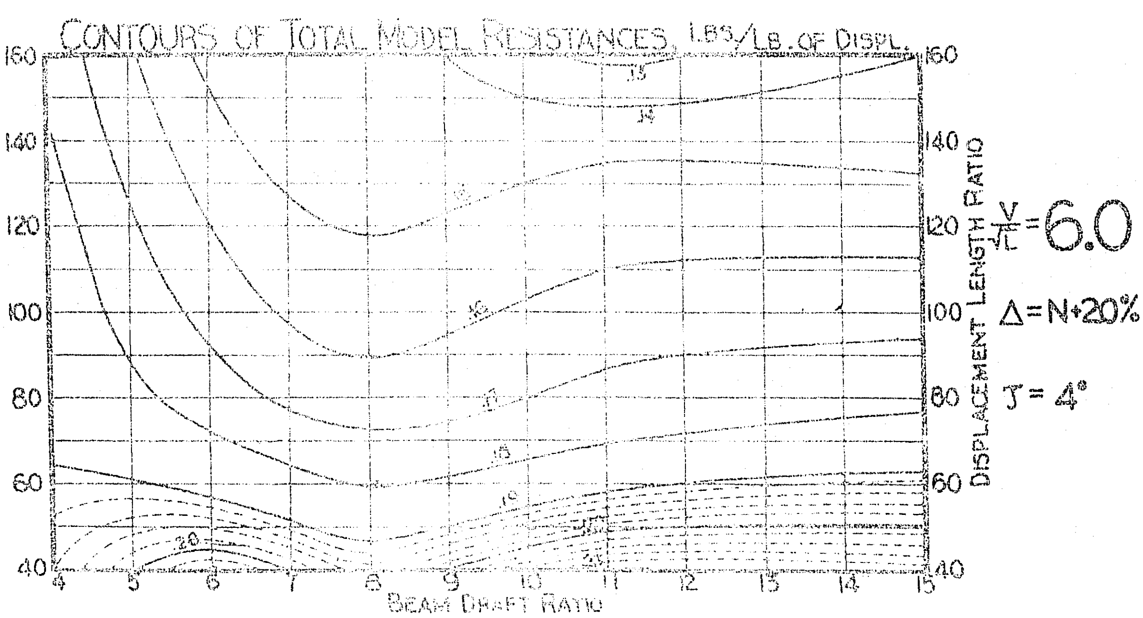

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
NOTE, INTERVAL CHANGE
.32
.34
.36
$\frac{V}{\sqrt{L}}$ = 5.5
Δ=N+20%
J = 0°

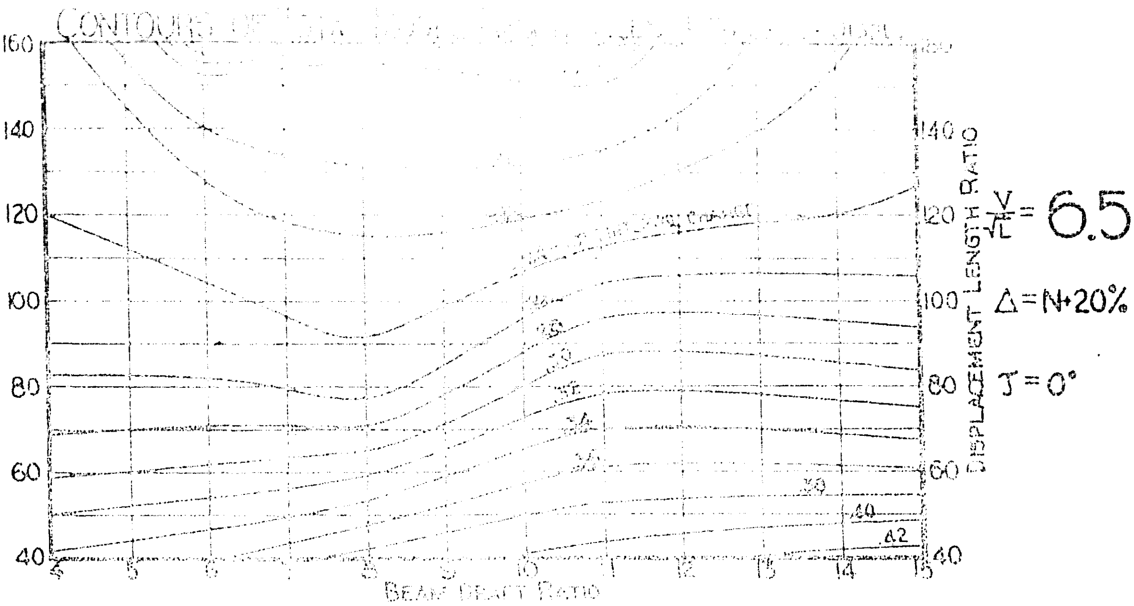

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
.15
.16
.17
.18
.19
.20
.21
.22
.23
.24
$\frac{V}{\sqrt{L}}$ = 5.5
Δ=N+20%
J = 2°


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
.14
.15
.16
.17
$\frac{V}{\sqrt{L}}$ = 5.5
Δ=N+20%
J = 4°

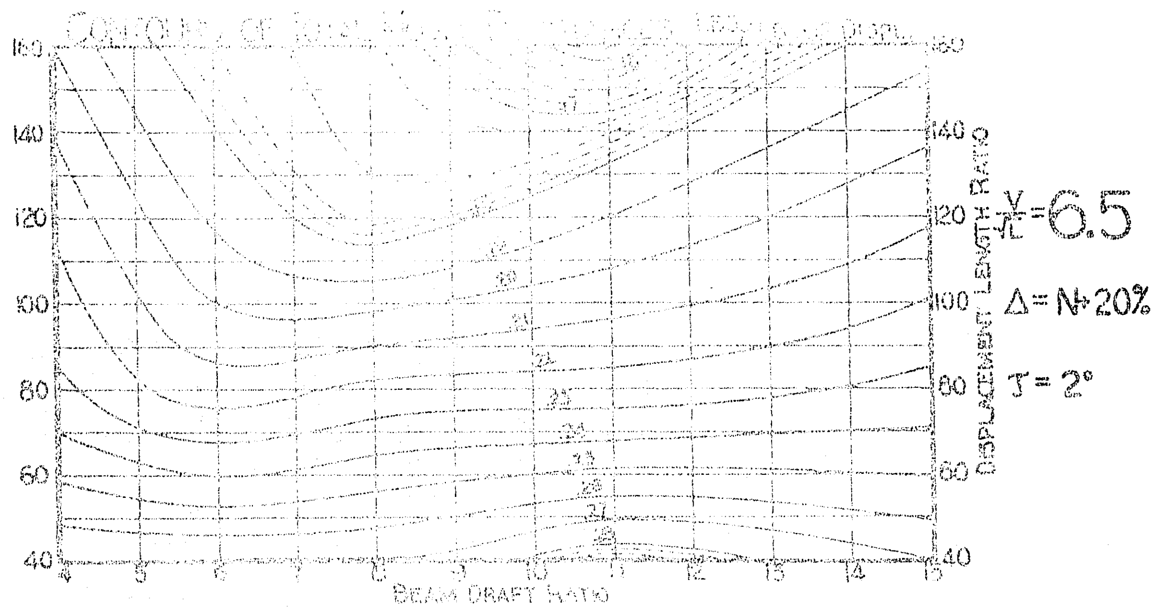

BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 6.0$
$\Delta = N + 20\%$
$\tau = 0°$


CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 6.0$
$\Delta = N + 20\%$
$\tau = 2°$

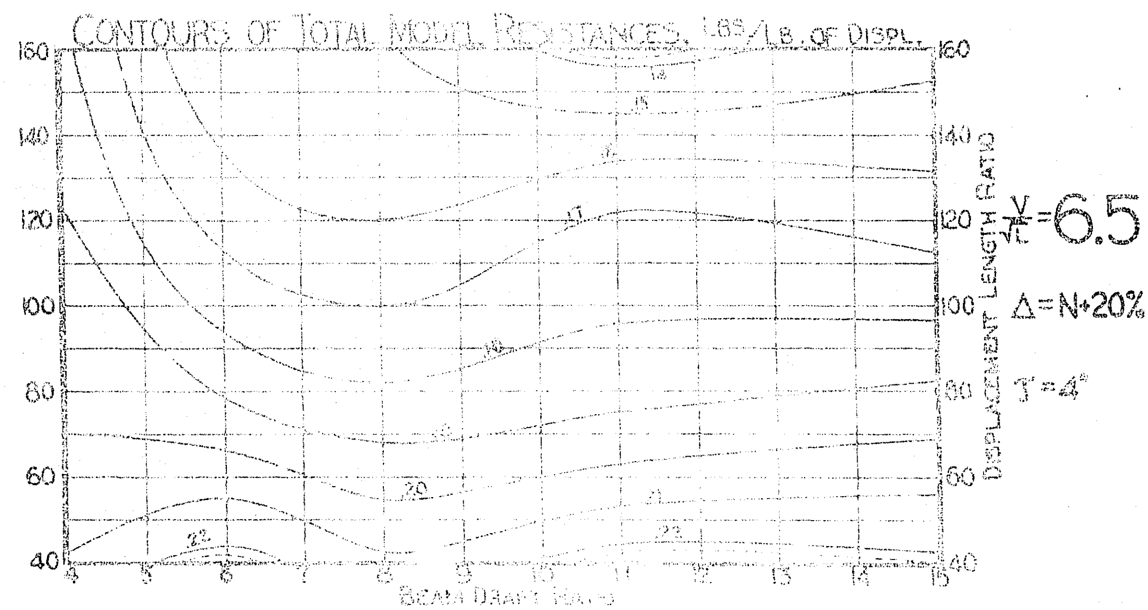

CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 6.0$
$\Delta = N + 20\%$
$\tau = 4°$



BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 6.5$
$\Delta = N+20\%$
$\tau = 0°$



BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 6.5$
$\Delta = N+20\%$
$\tau = 2°$



CONTOURS OF TOTAL MODEL RESISTANCES, LBS/LB. OF DISPL.
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 6.5$
$\Delta = N+20\%$
$\tau = 4°$

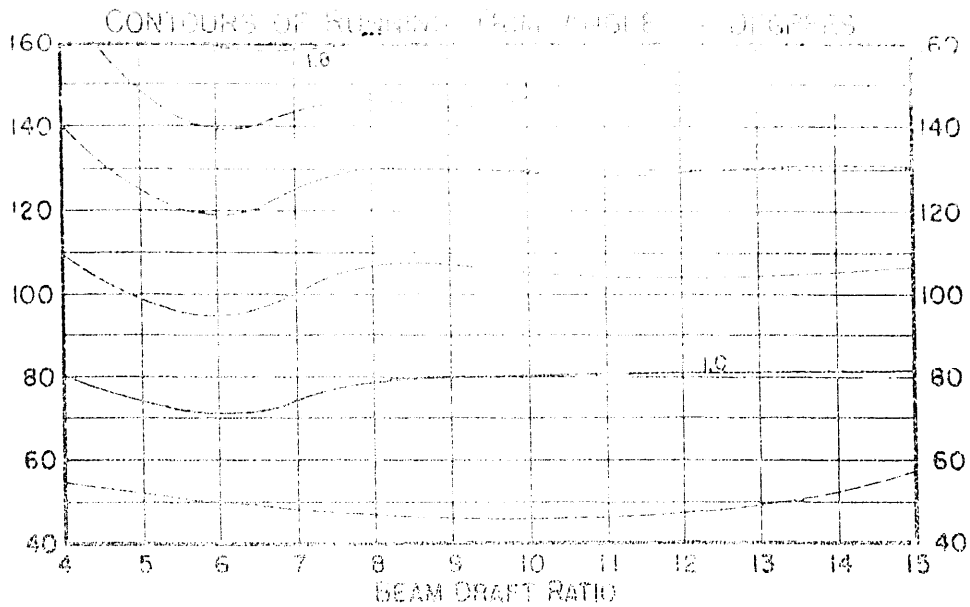
CONTOURS

OF

RUNNING TRIM

Speed-Length Ratios 1.5-6.5 in Steps of 0.5

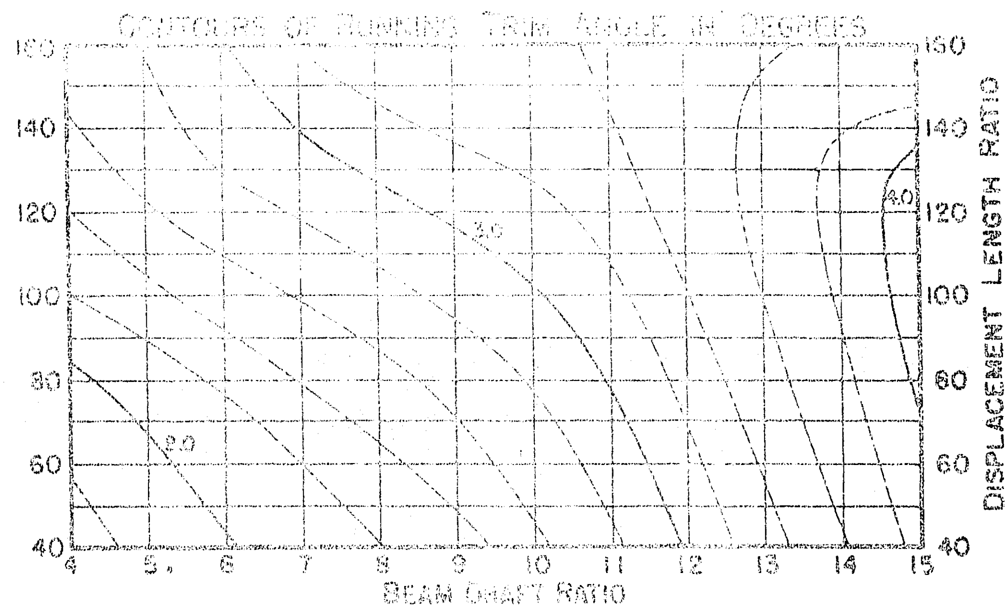
			Pages
100% Displacement		(N)	47 to 57
110%	"	(N + 10%)	58 to 68
120%	"	(N + 20%)	69 to 79



$\frac{V}{\sqrt{L}} = 1.5$

$\Delta = N$

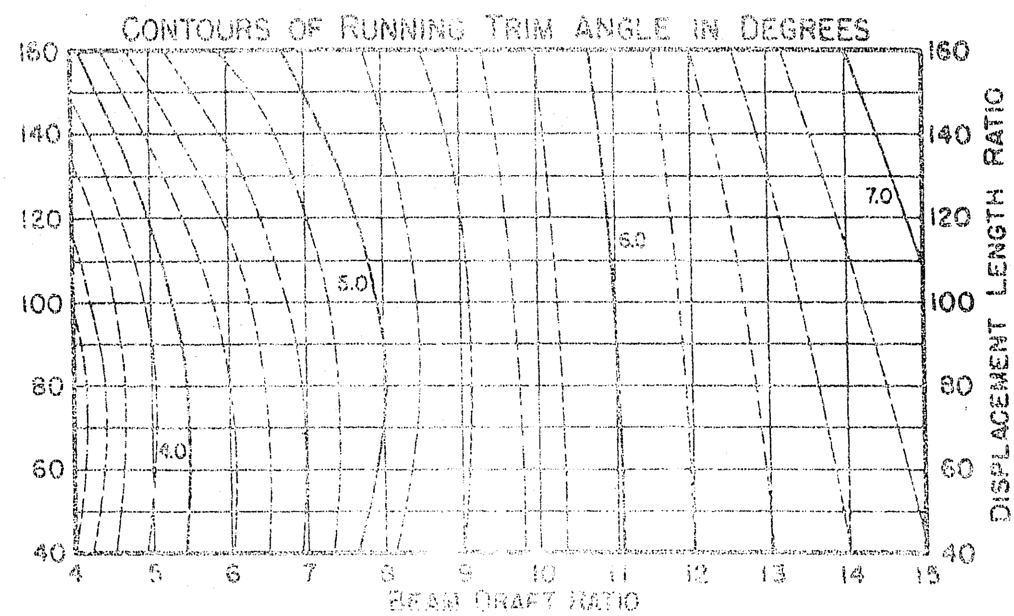
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 1.5$

$\Delta = N$

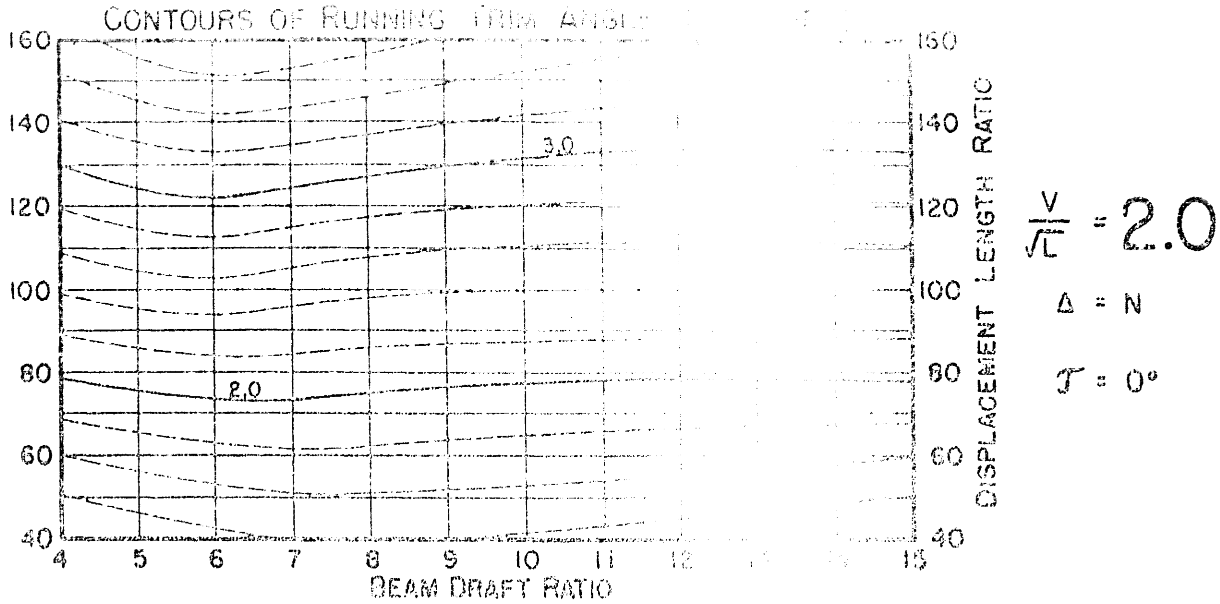
$\tau = 2°$

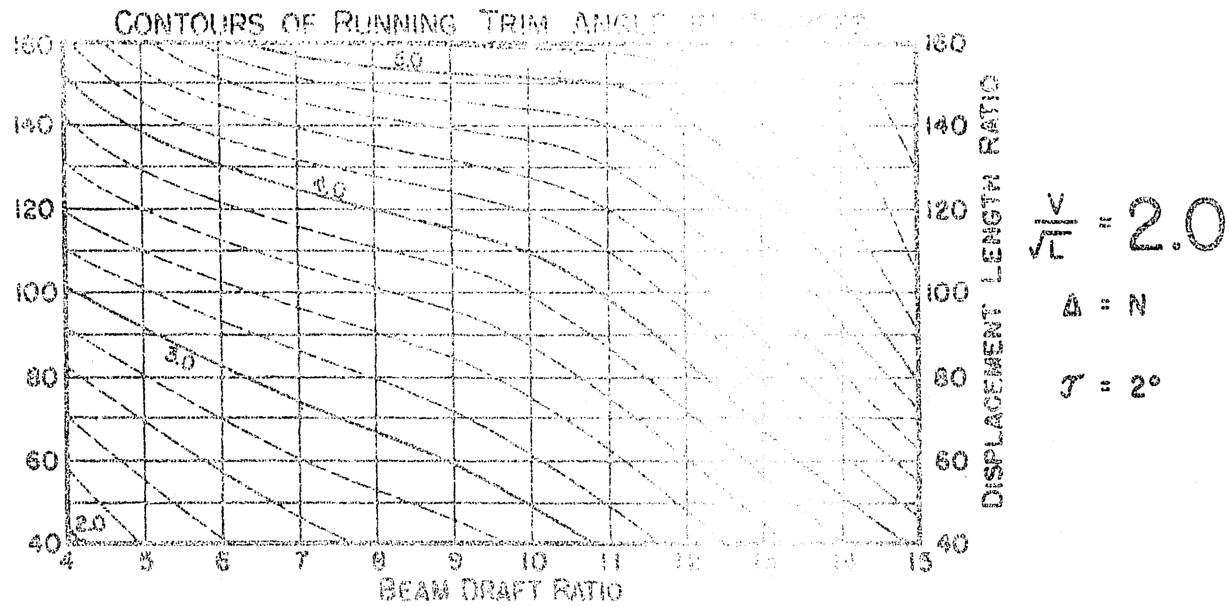


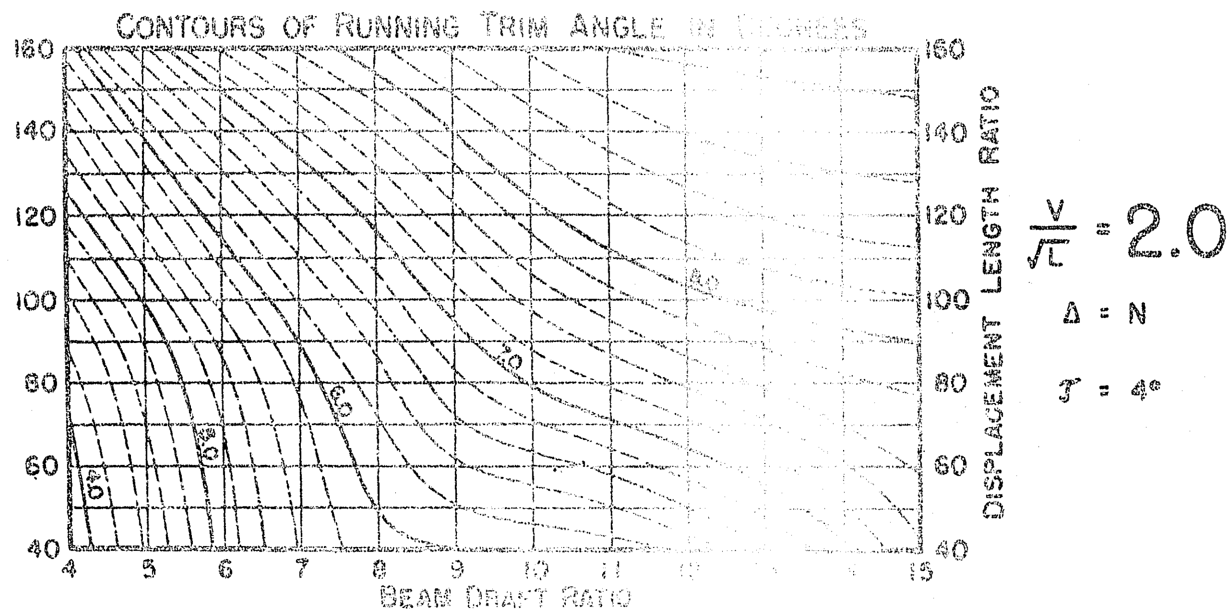
$\frac{V}{\sqrt{L}} = 1.5$

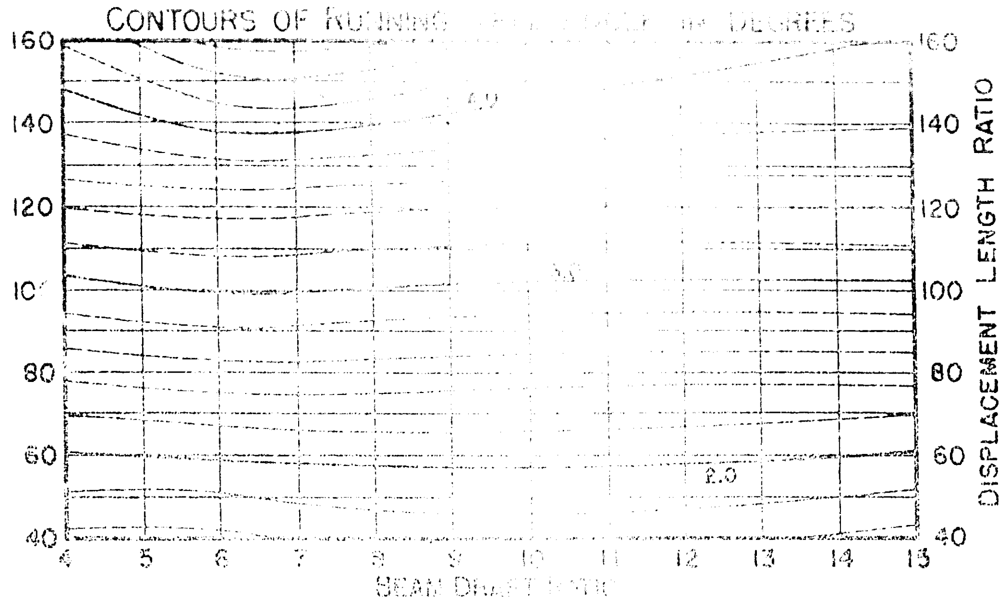
$\Delta = N$

$\tau = 4°$


CONTOURS OF RUNNING TRIM
3.0
2.0
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 2.0$
Δ = N
τ = 0°


CONTOURS OF RUNNING TRIM
5.0
4.0
3.0
2.0
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 2.0$
Δ = N
τ = 2°

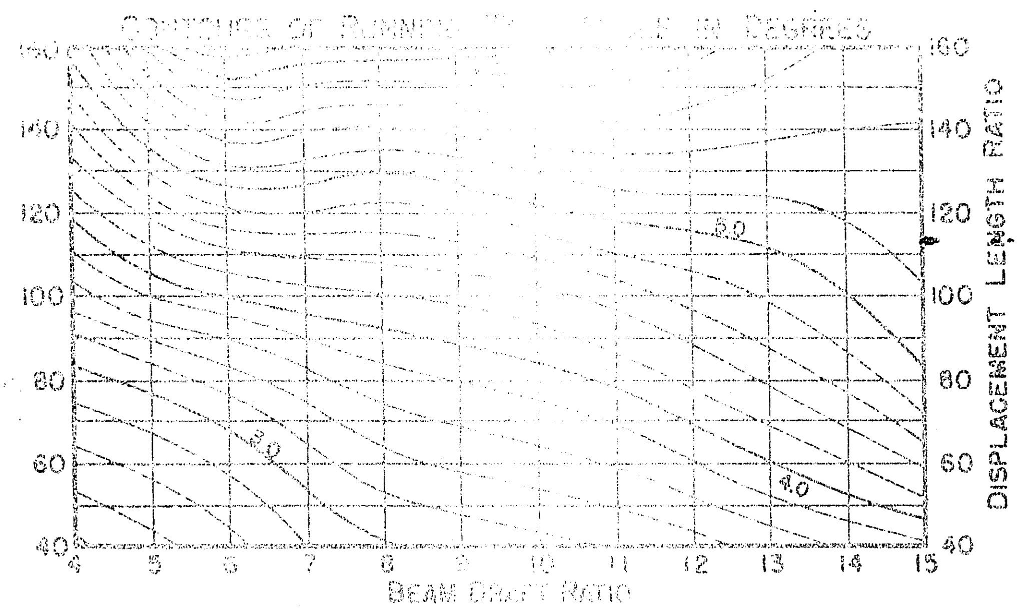

CONTOURS OF RUNNING TRIM ANGLE
8.0
7.0
6.0
5.0
4.0
BEAM DRAFT RATIO
DISPLACEMENT LENGTH RATIO
$\frac{V}{\sqrt{L}} = 2.0$
Δ = N
τ = 4°



$\frac{V}{\sqrt{L}} = 2.5$

$\Delta = N$

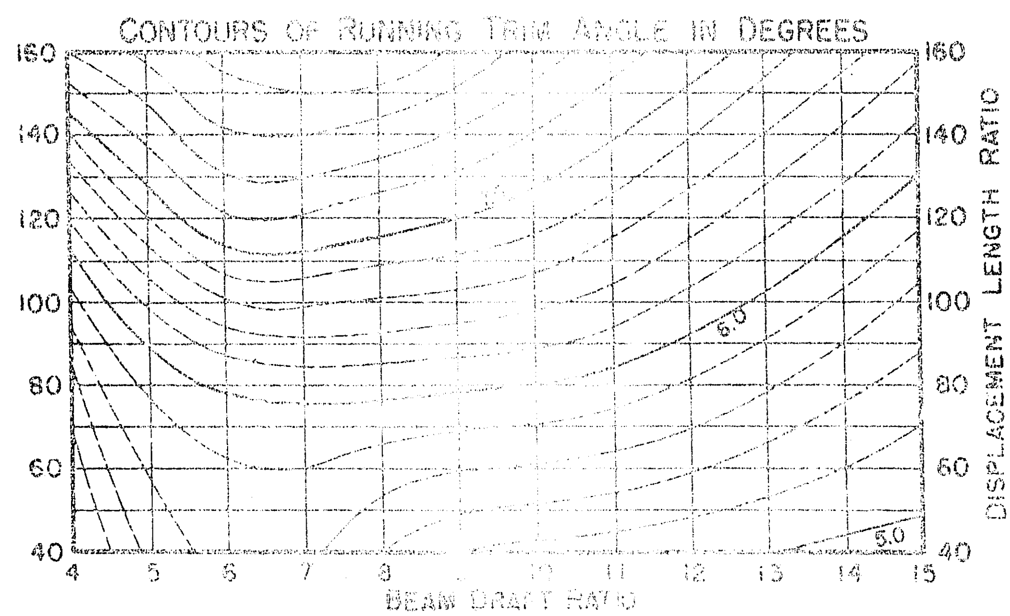
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 2.5$

$\Delta = N$

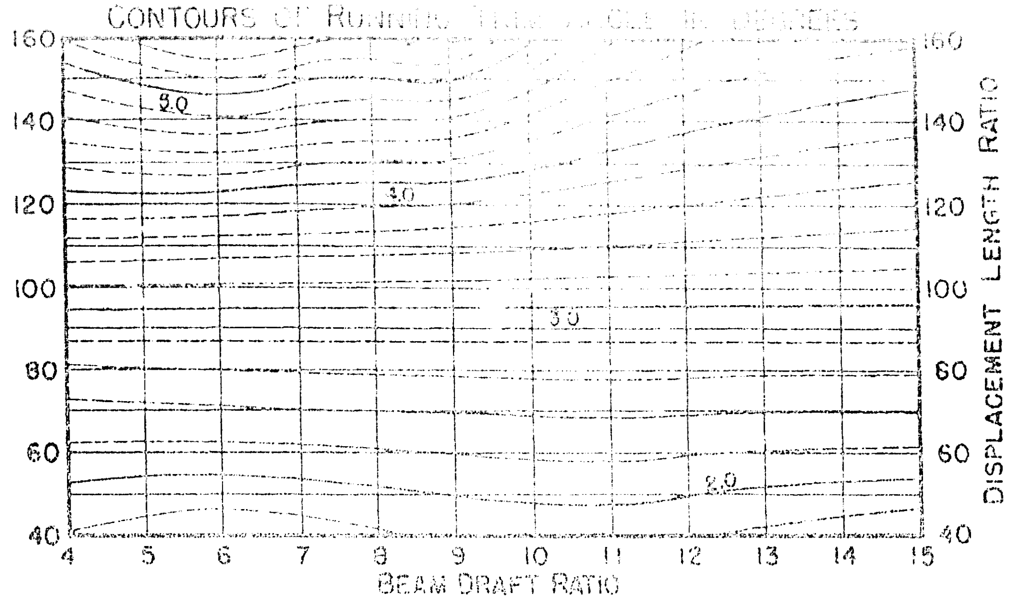
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 2.5$

$\Delta = N$

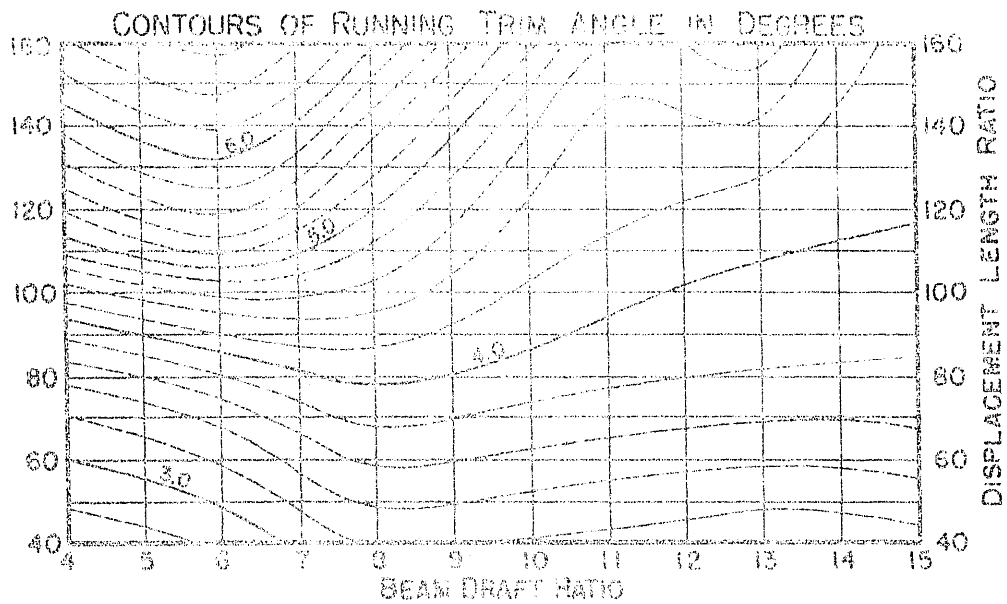
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N$

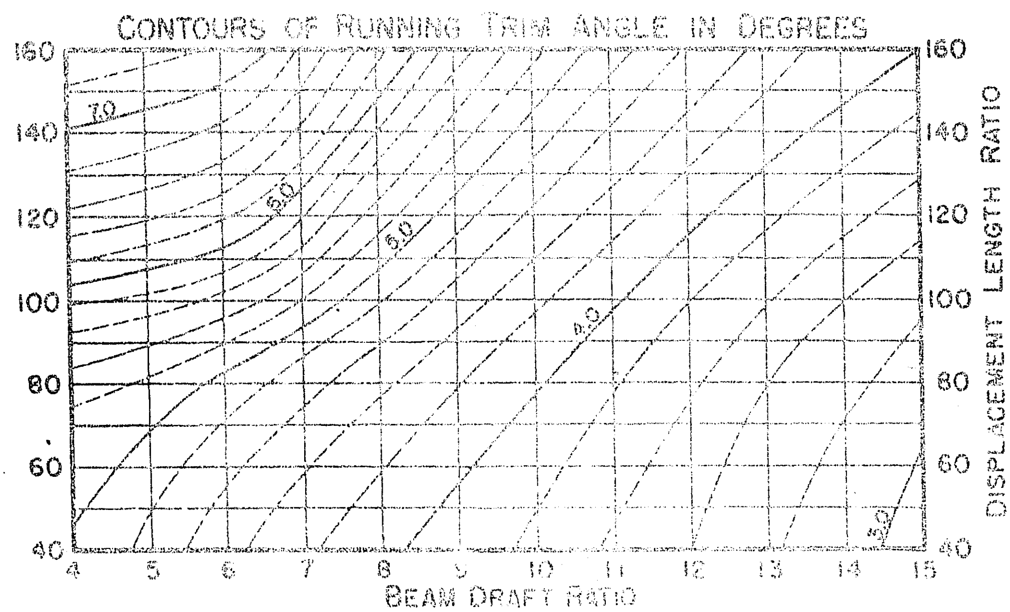
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N$

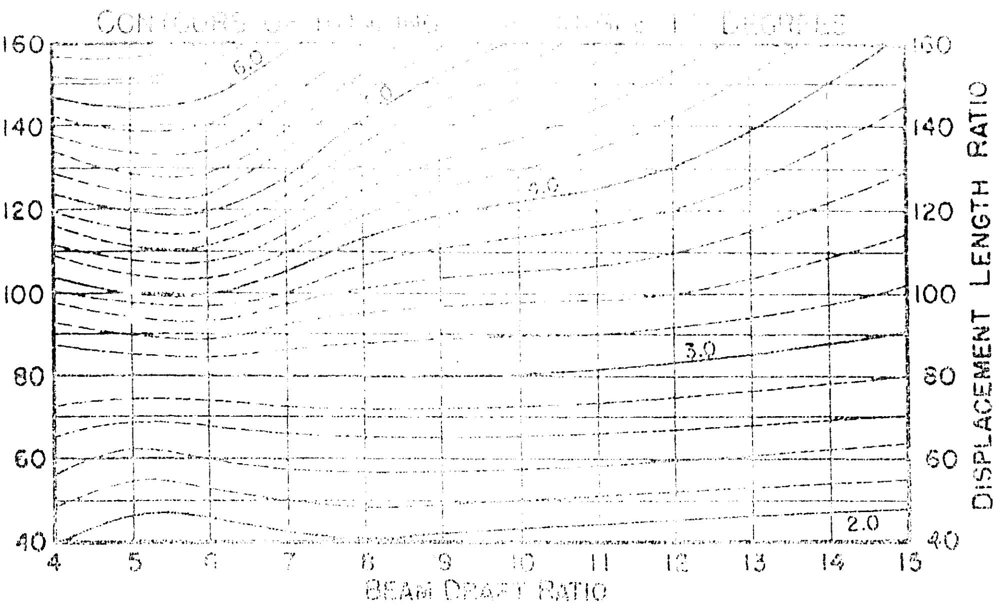
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N$

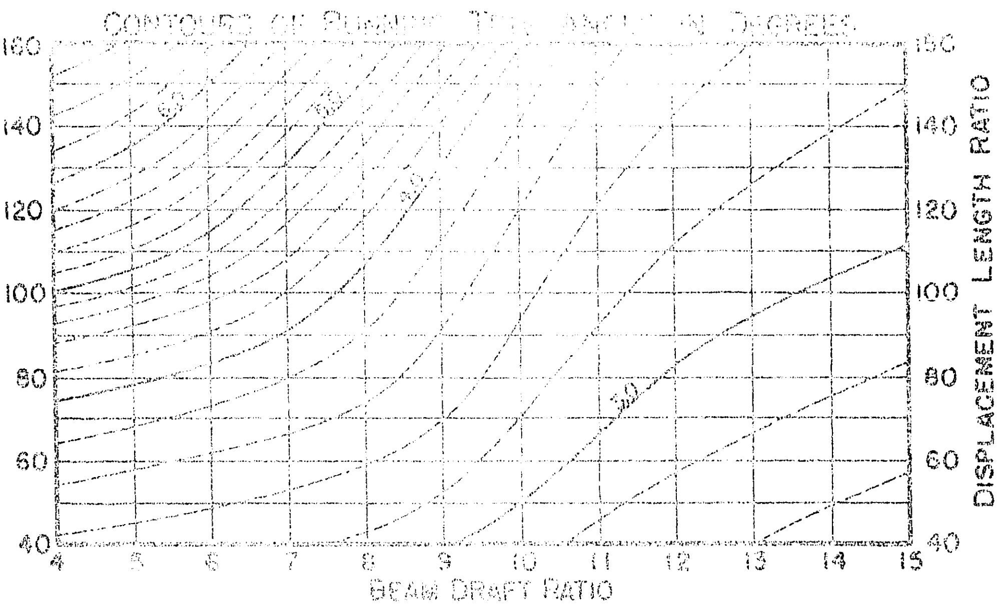
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 3.5$

$\Delta = N$

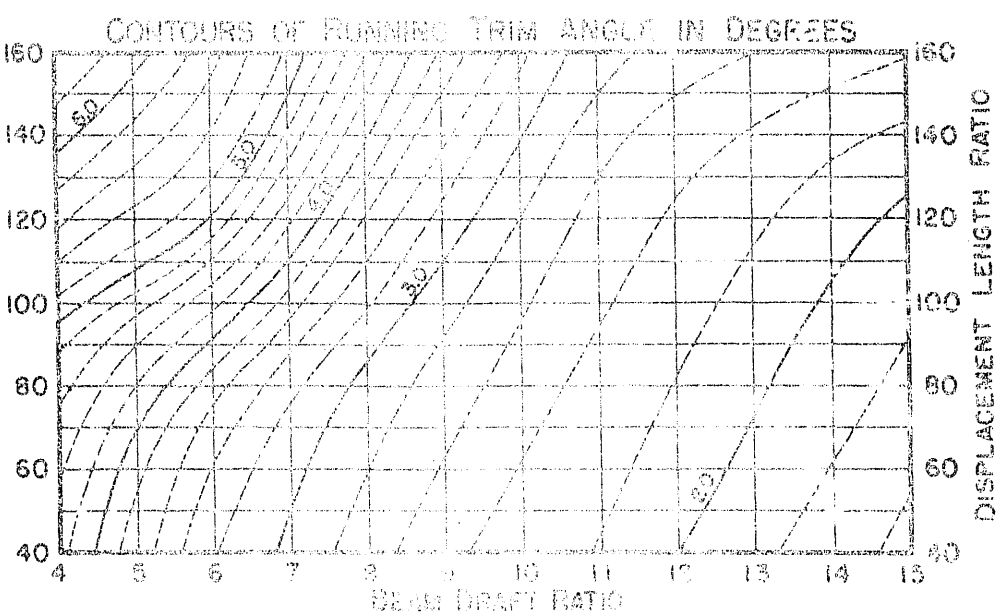
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 3.5$

$\Delta = N$

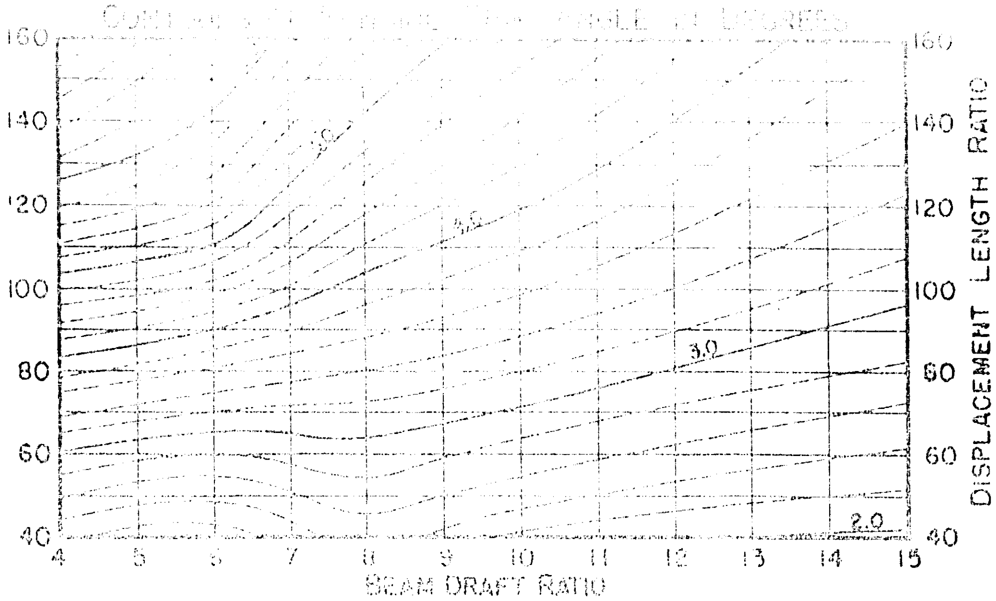
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 3.5$

$\Delta = N$

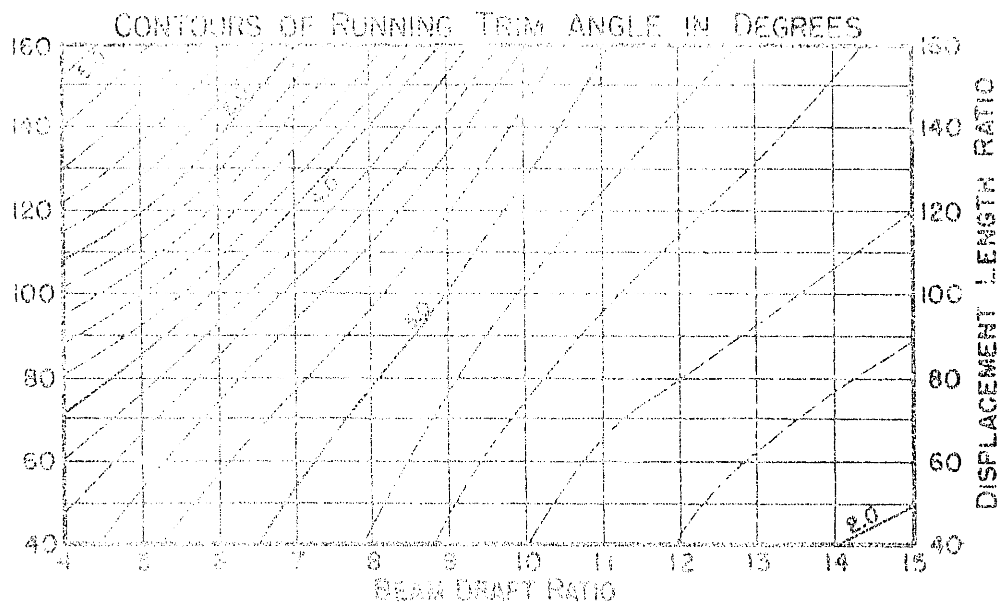
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 4.0$

Δ = N

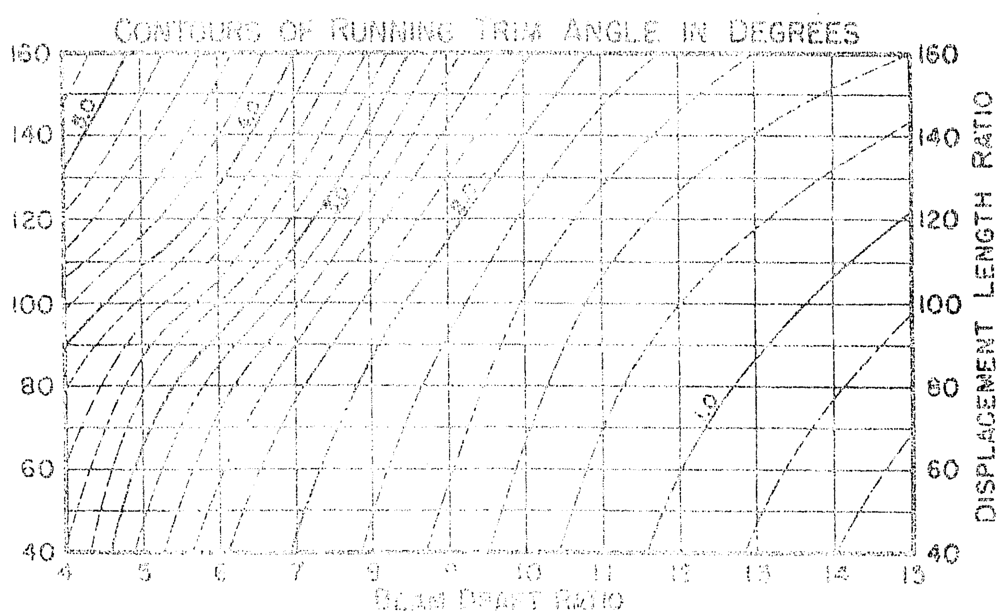
$\mathcal{T}$ = 0°



$\frac{V}{\sqrt{L}} = 4.0$

Δ = N

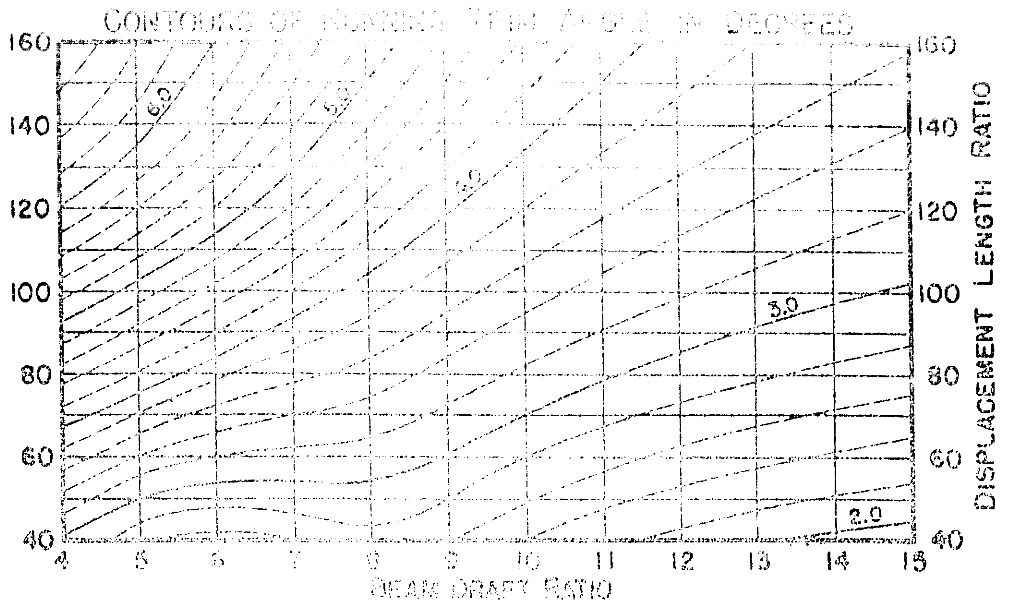
$\mathcal{T}$ = 2°



$\frac{V}{\sqrt{L}} = 4.0$

Δ = N

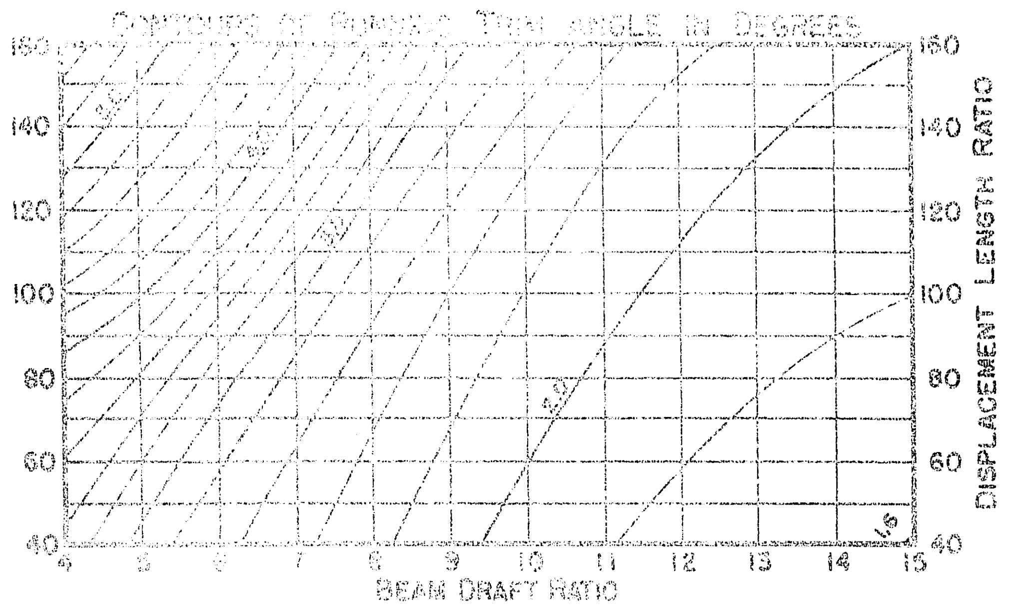
$\mathcal{T}$ = 4°



$\frac{V}{\sqrt{L}} = 4.5$

Δ = N

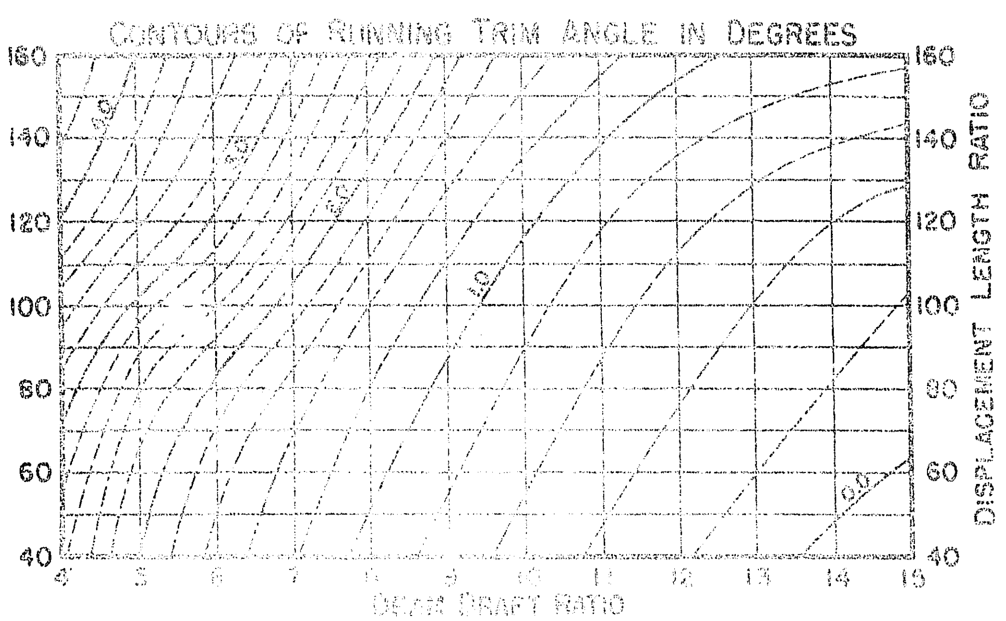
τ = 0°



$\frac{V}{\sqrt{L}} = 4.5$

Δ = N

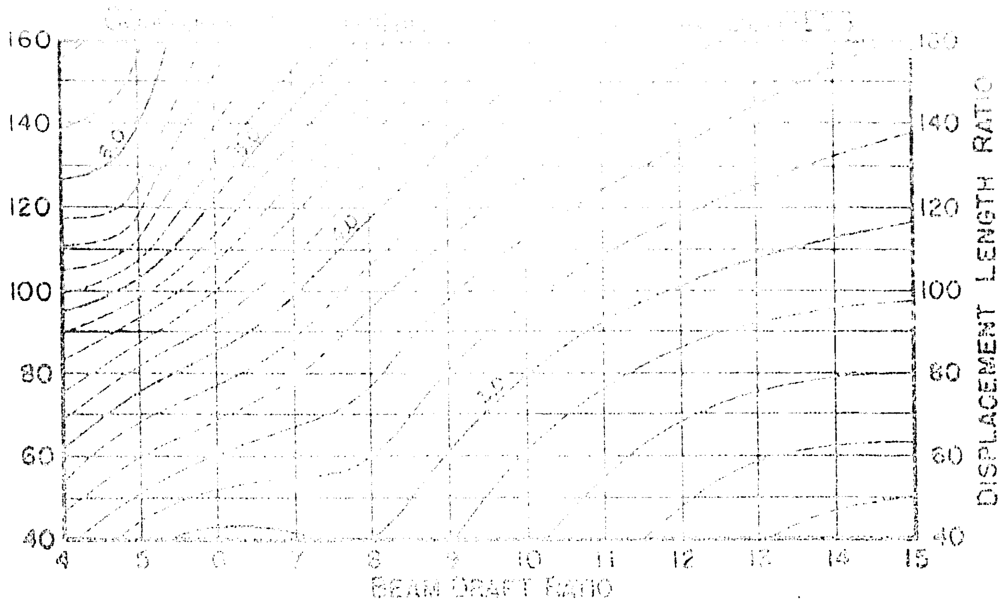
τ = 2°



$\frac{V}{\sqrt{L}} = 4.5$

Δ = N

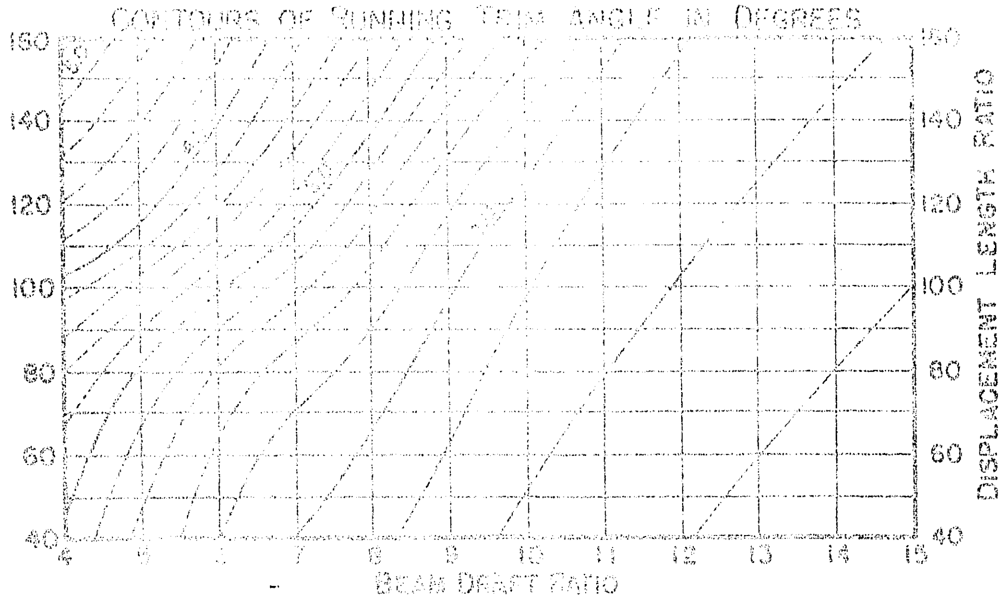
τ = 4°



$\frac{V}{\sqrt{L}} = 5.0$

Δ = N

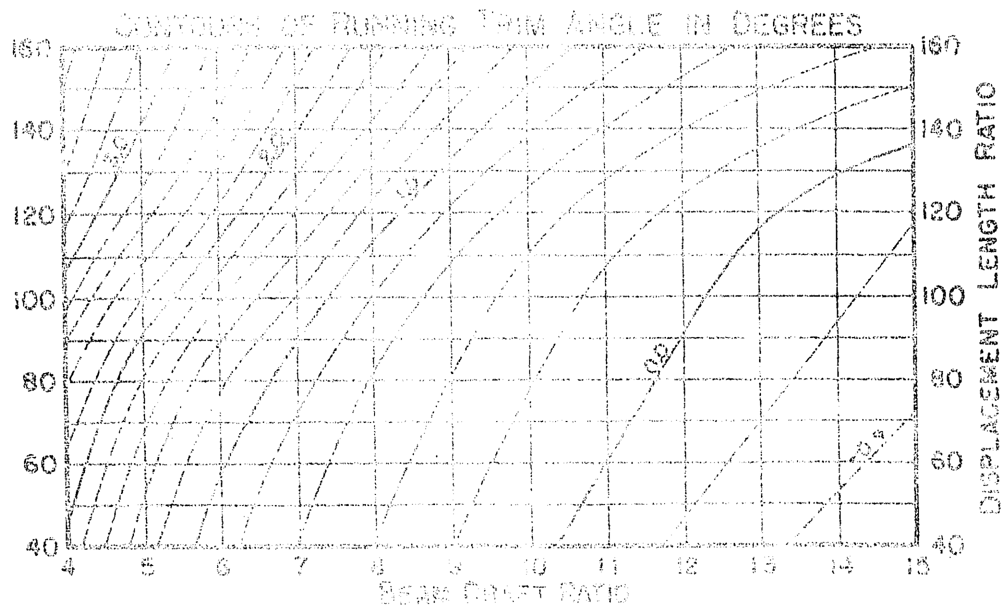
τ = 0°



$\frac{V}{\sqrt{L}} = 5.0$

Δ = N

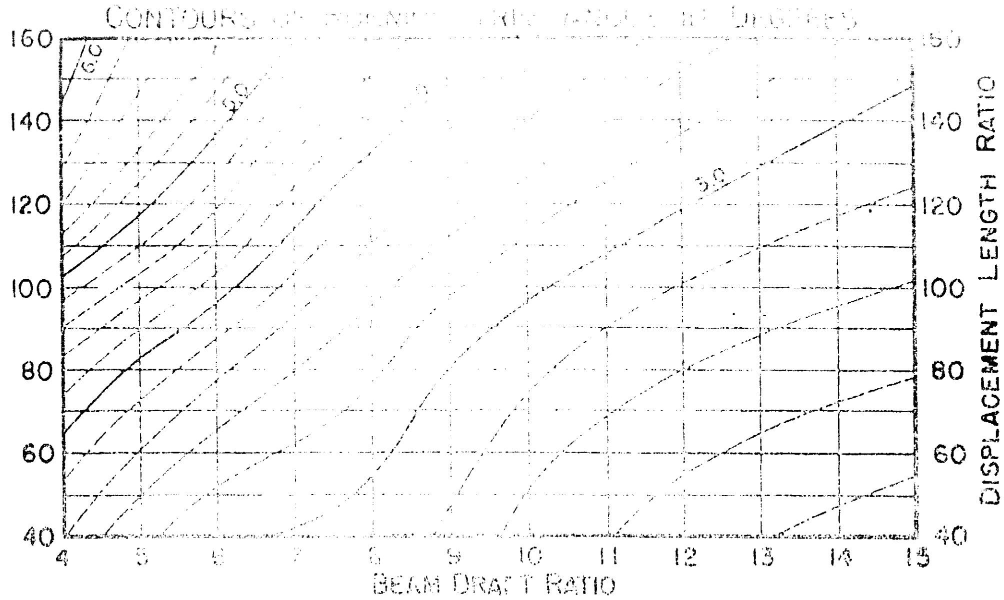
τ = 2°



$\frac{V}{\sqrt{L}} = 5.0$

Δ = N

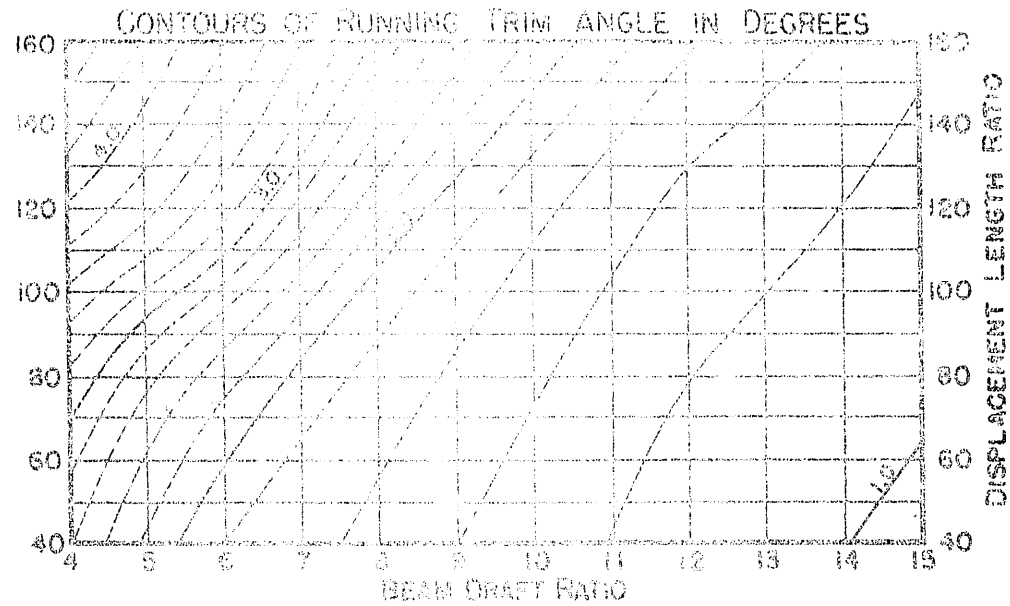
τ = 4°



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N$

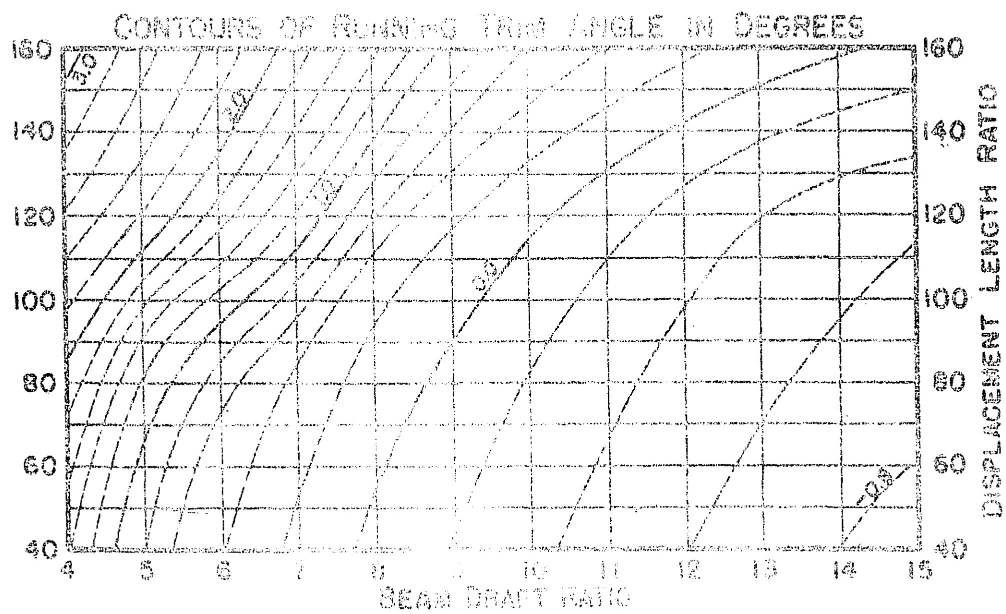
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N$

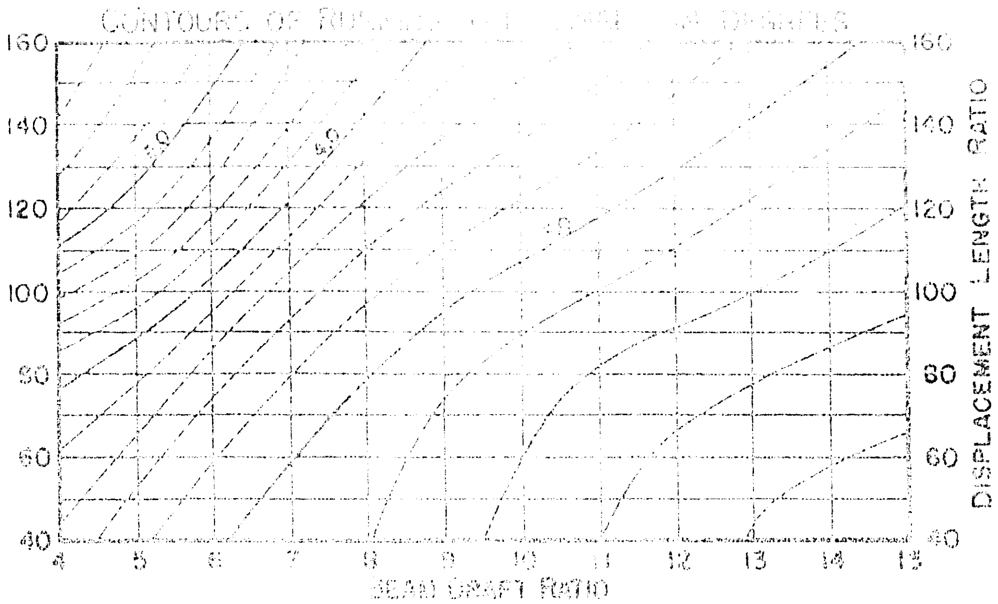
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N$

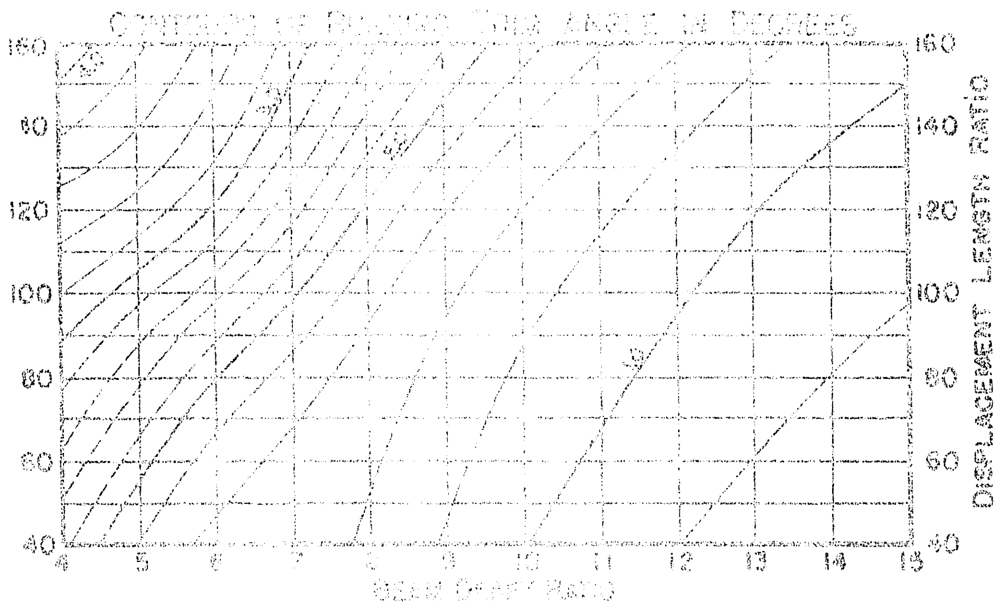
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 6.0$

$\Delta = N$

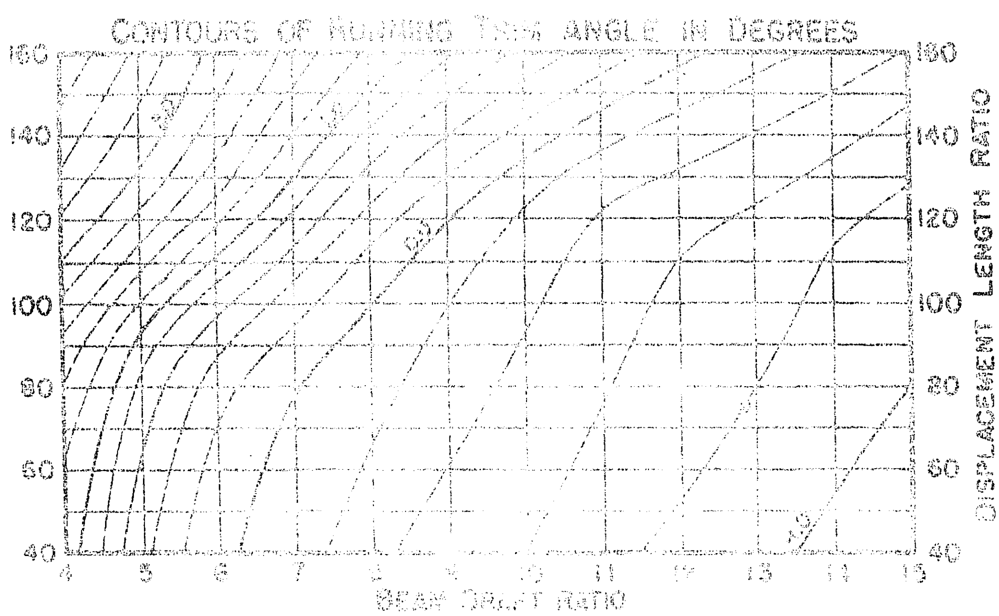
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 6.0$

$\Delta = N$

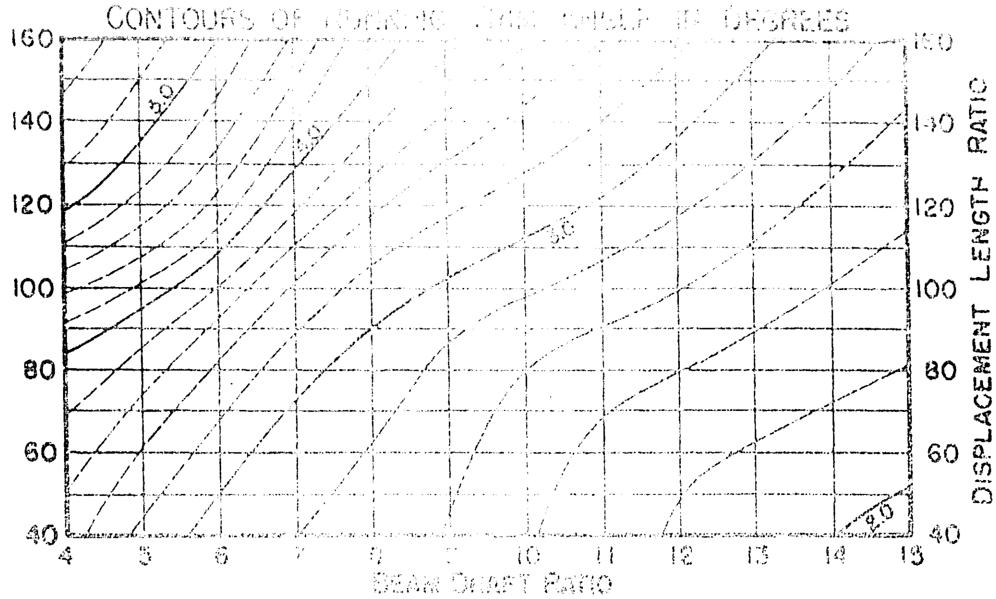
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 6.0$

$\Delta = N$

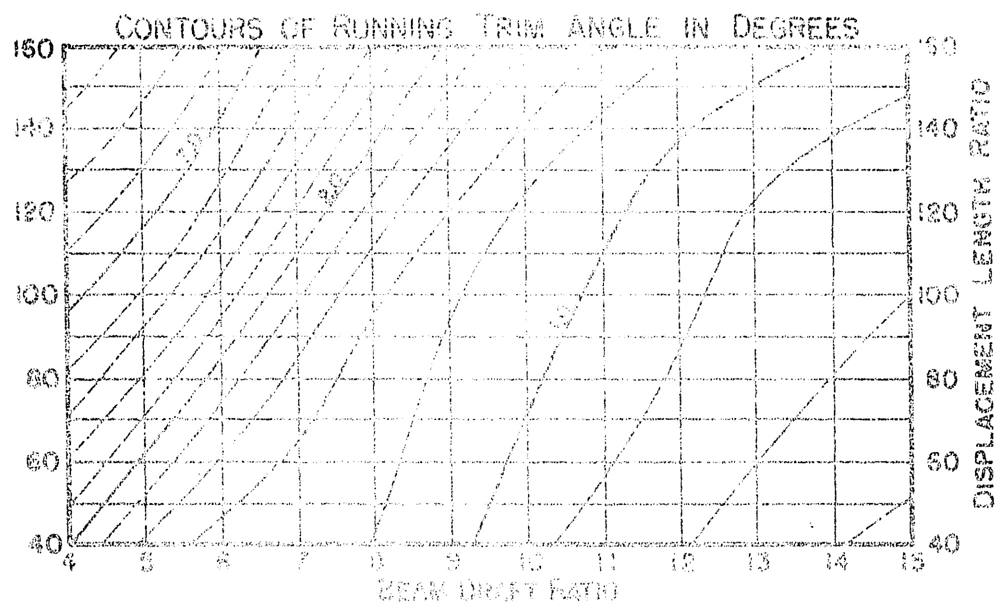
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 6.5$

$\Delta = N$

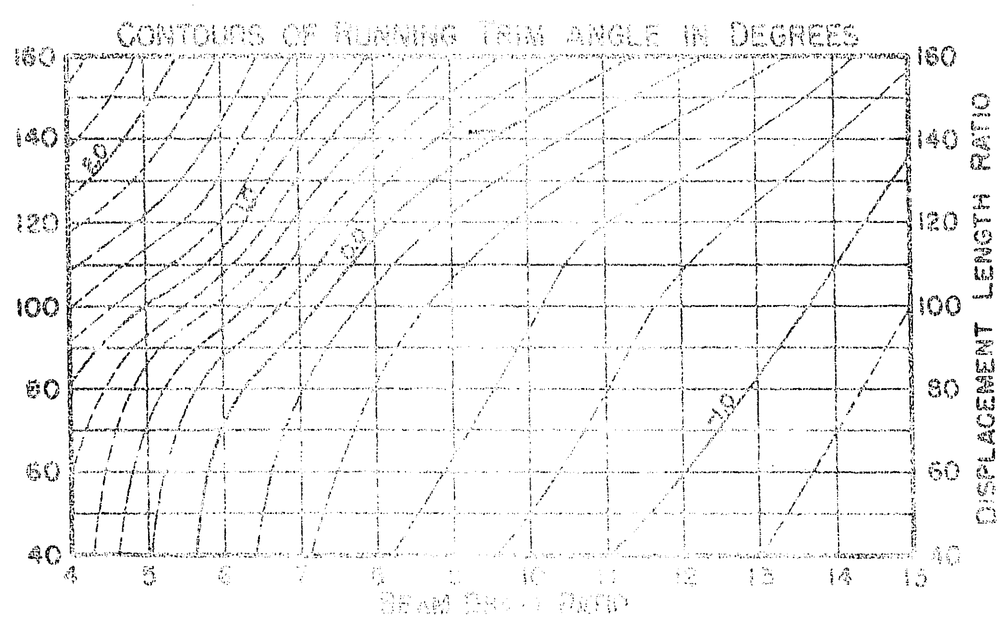
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 6.5$

$\Delta = N$

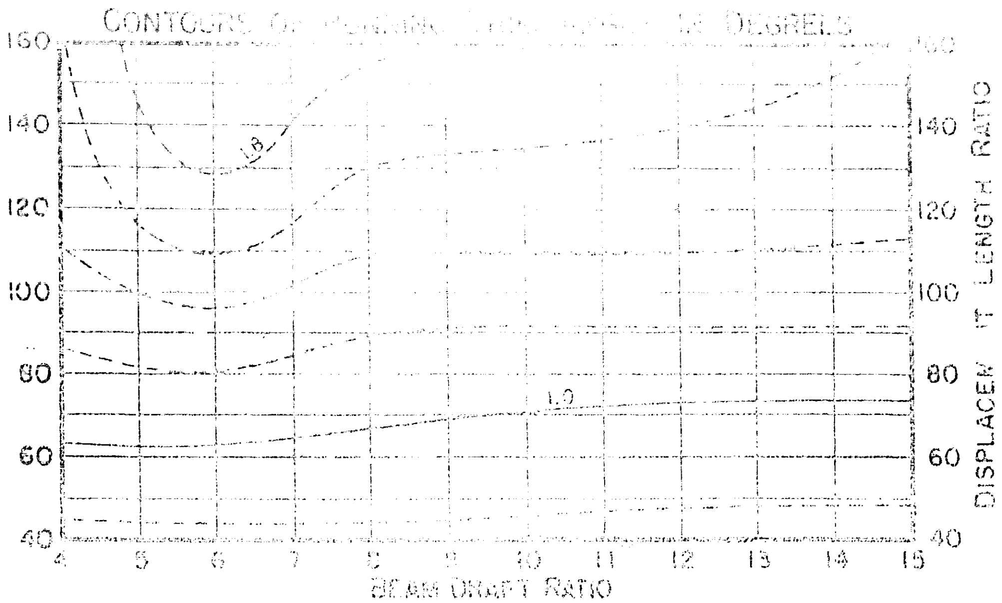
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 6.5$

$\Delta = N$

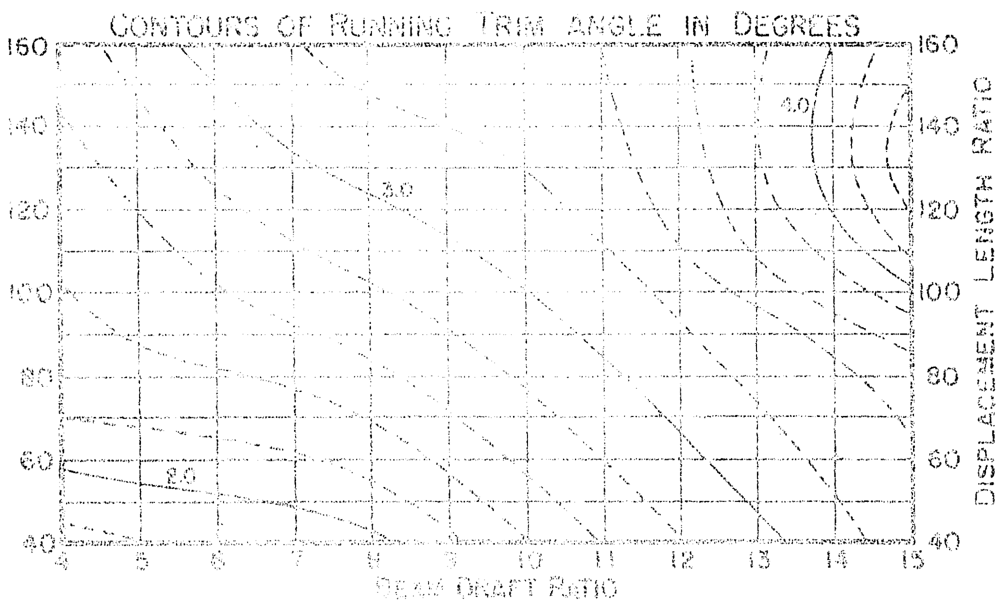
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 1.5$

Δ = N + 10%

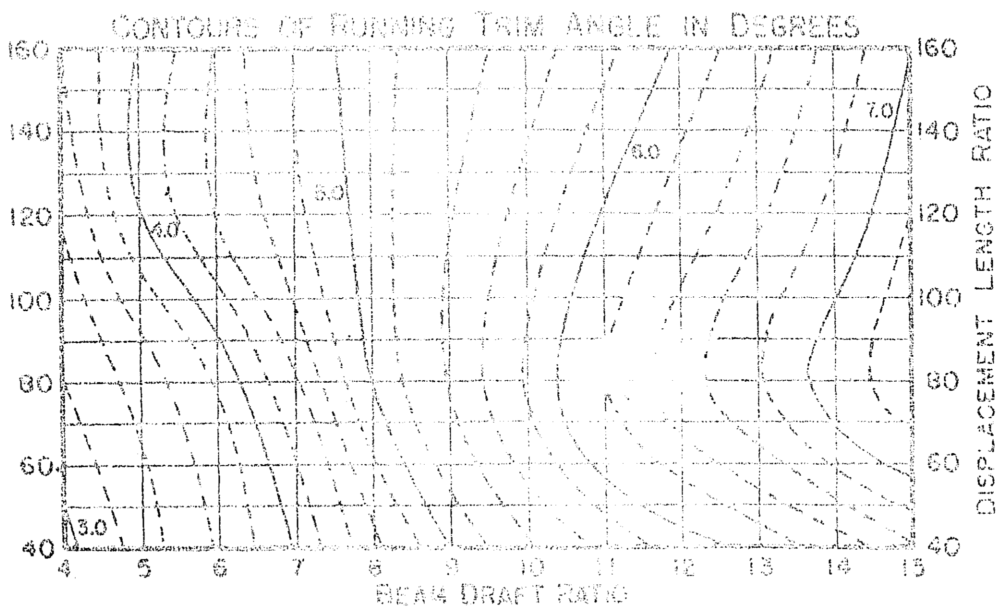
τ = 0°



$\frac{V}{\sqrt{L}} = 1.5$

Δ = N + 10%

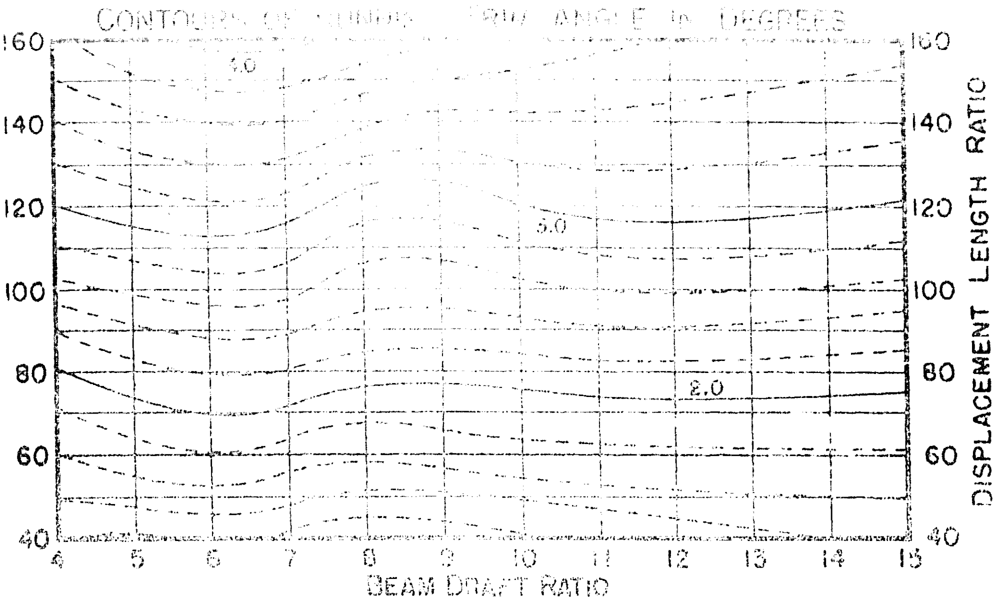
τ = 2°



$\frac{V}{\sqrt{L}} = 1.5$

Δ = N + 10%

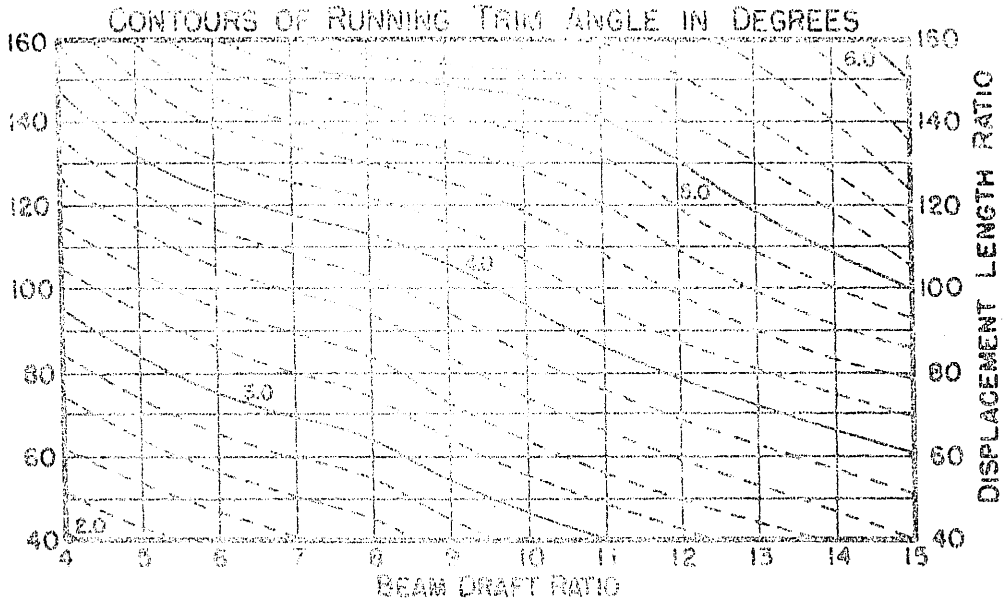
τ = 4°



$$\frac{V}{\sqrt{L}} = 2.0$$

$\Delta = N + 10\%$

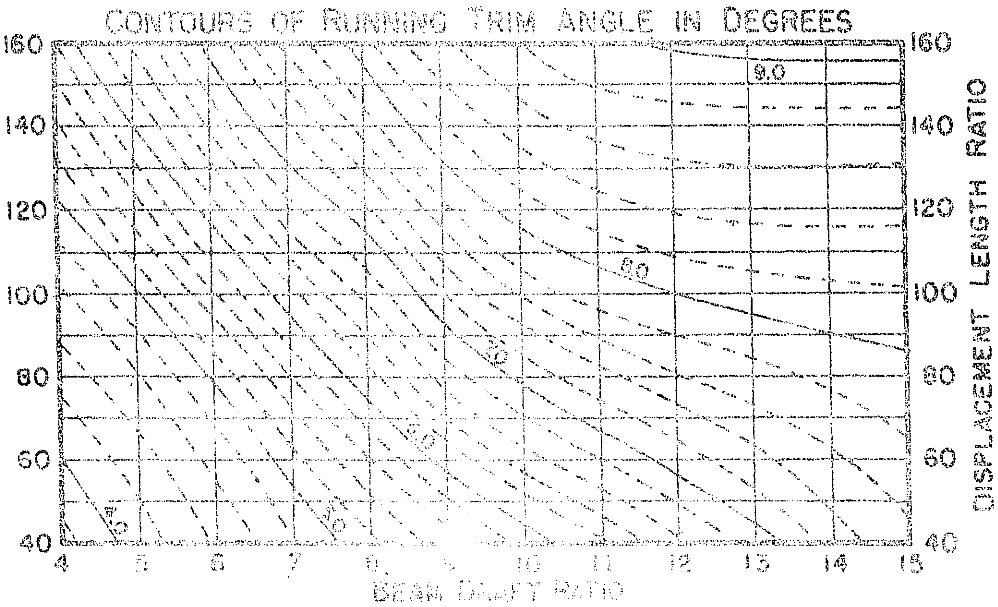
$\tau = 0°$



$$\frac{V}{\sqrt{L}} = 2.0$$

$\Delta = N + 10\%$

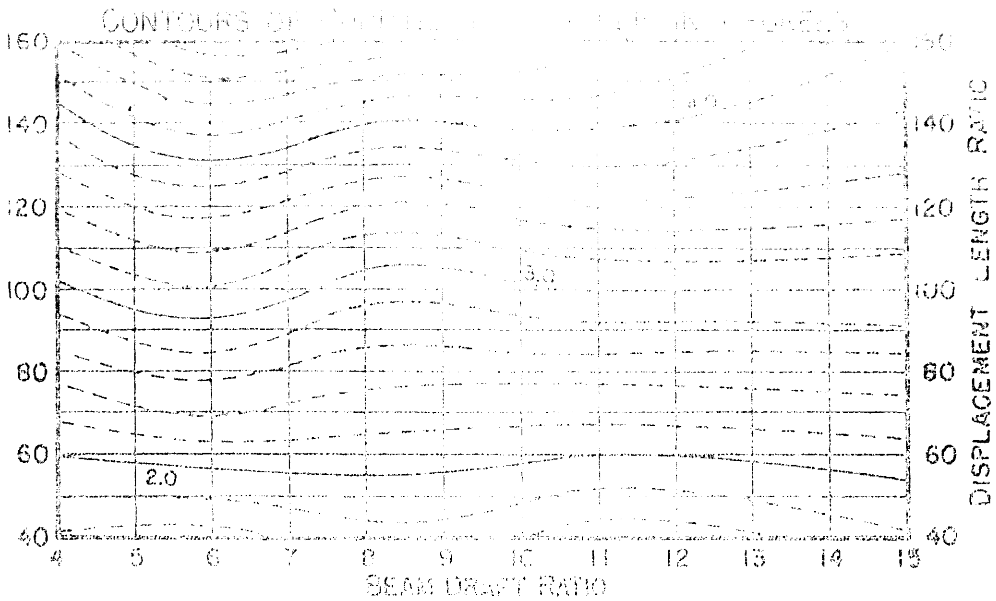
$\tau = 2°$



$$\frac{V}{\sqrt{L}} = 2.0$$

$\Delta = N + 10\%$

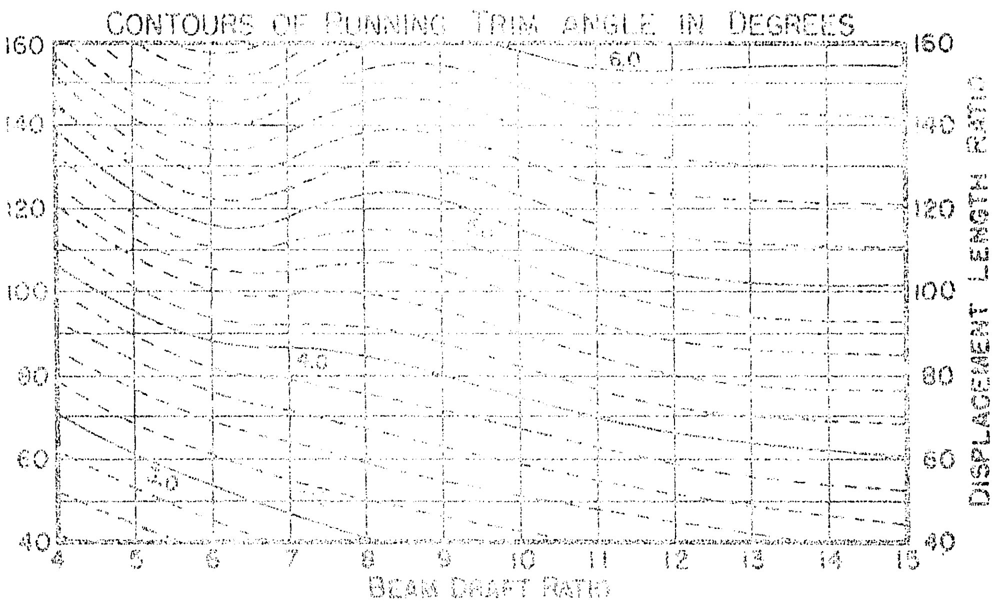
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 2.5$

Δ = N + 10%

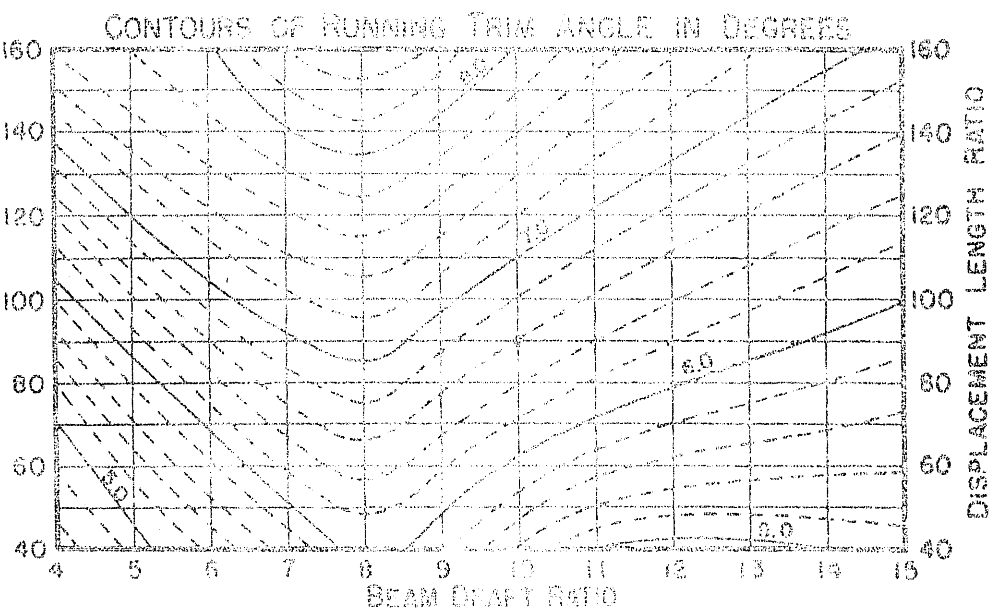
τ = 0°



$\frac{V}{\sqrt{L}} = 2.5$

Δ = N + 10%

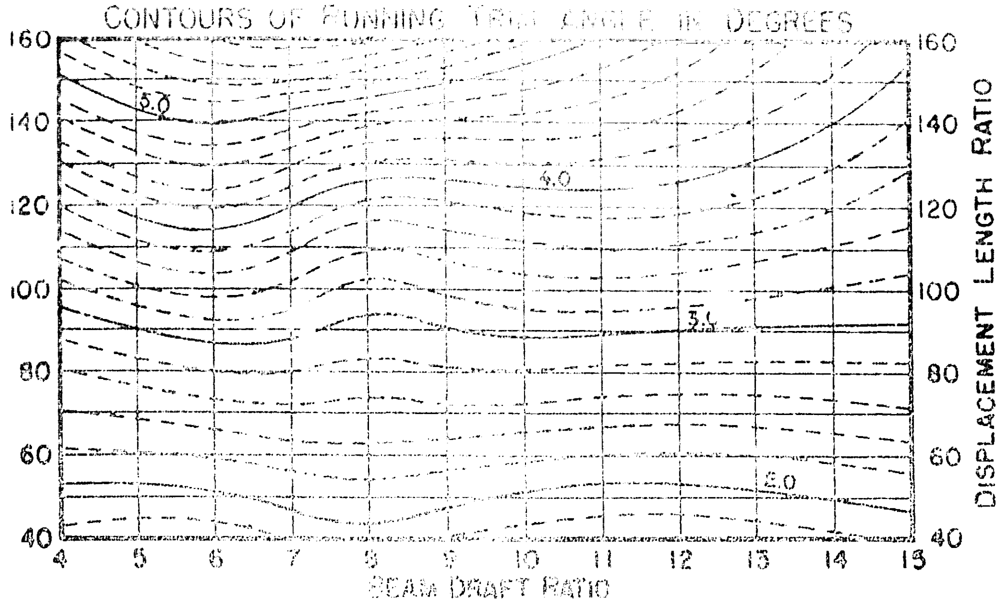
τ = 2°



$\frac{V}{\sqrt{L}} = 2.5$

Δ = N + 10%

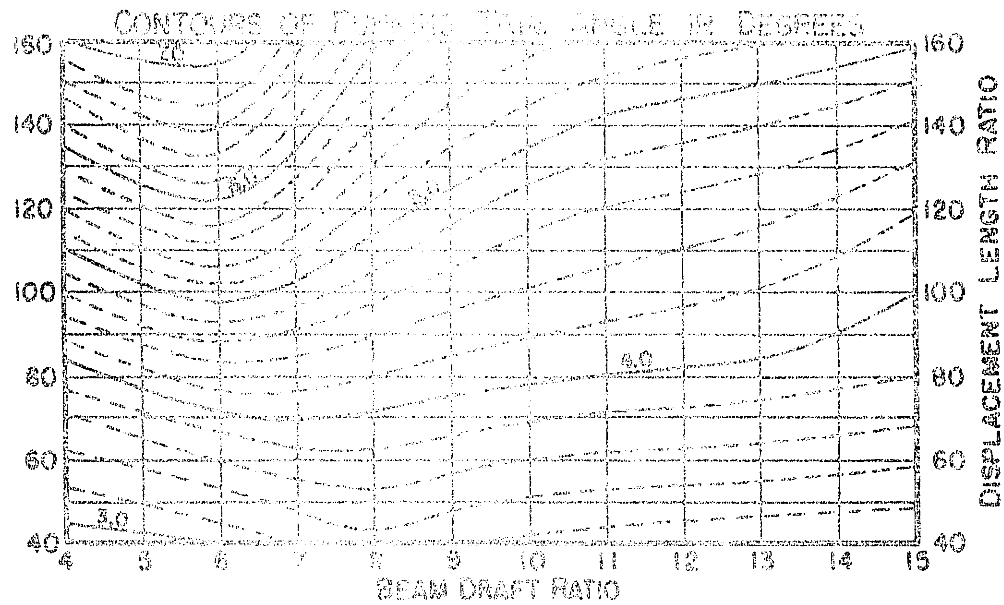
τ = 4°



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 10\%$

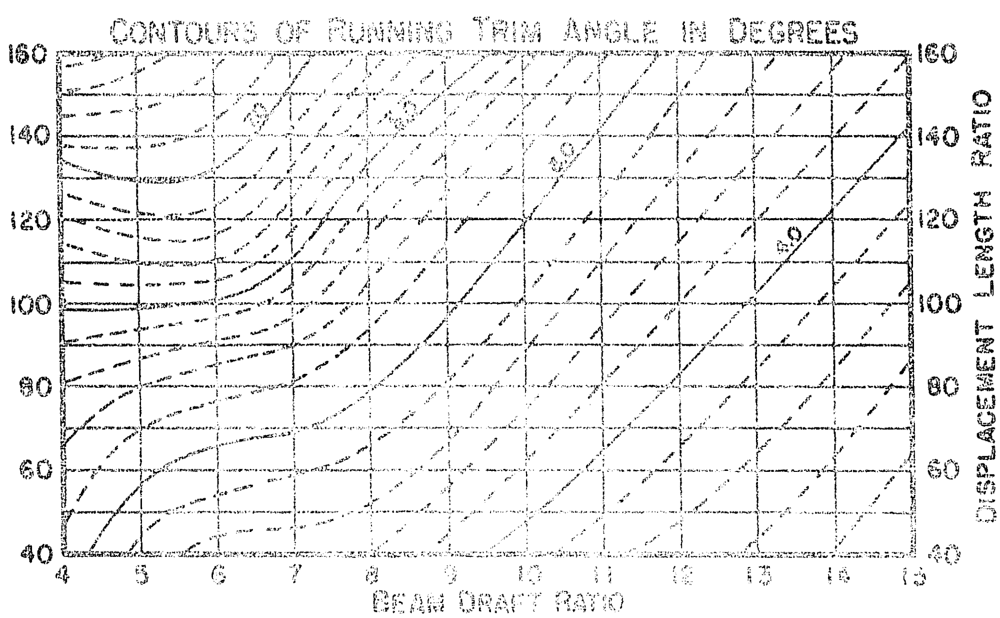
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 10\%$

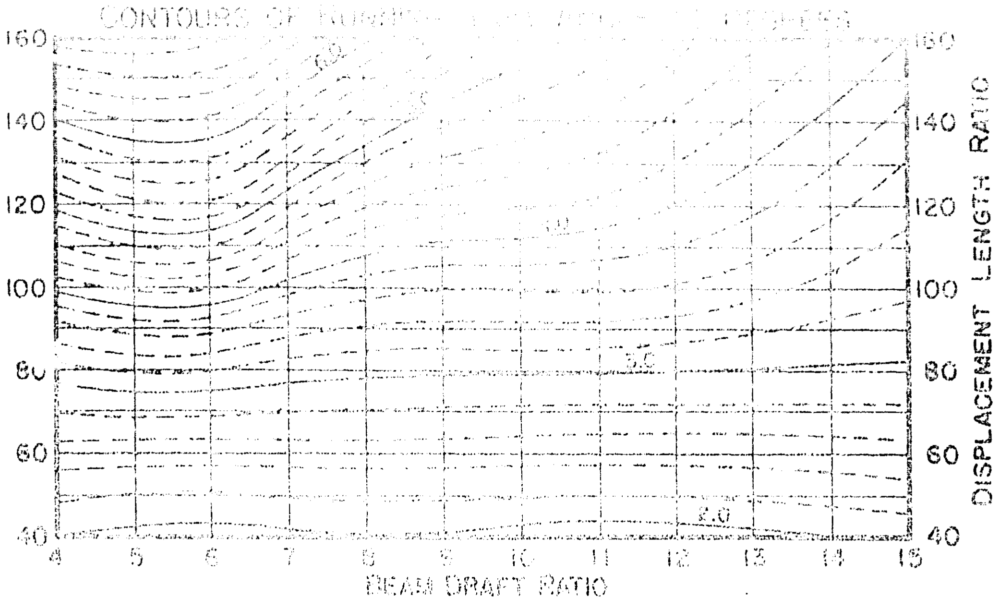
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 10\%$

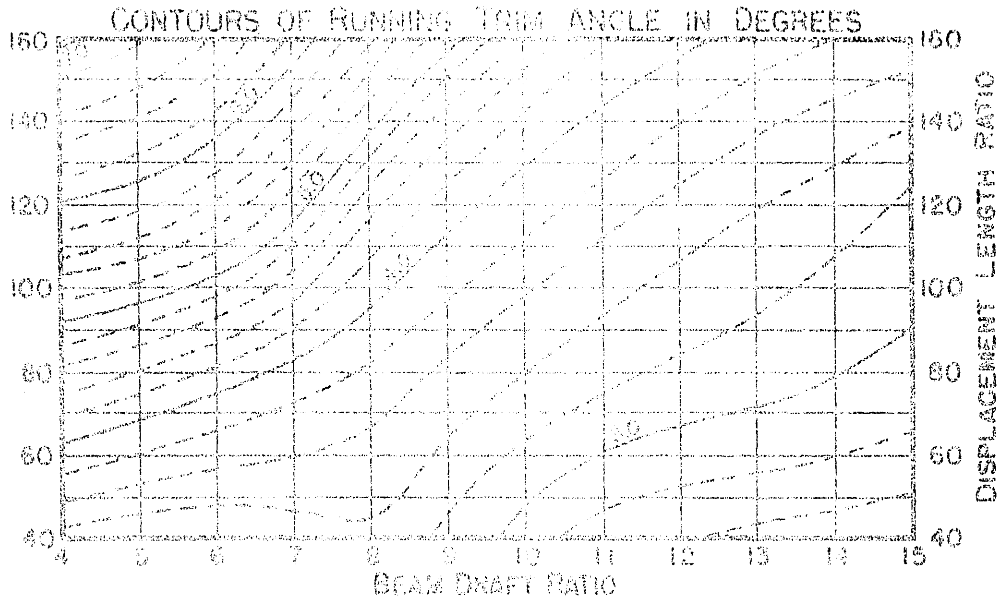
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 3.5$

$\Delta = N + 10\%$

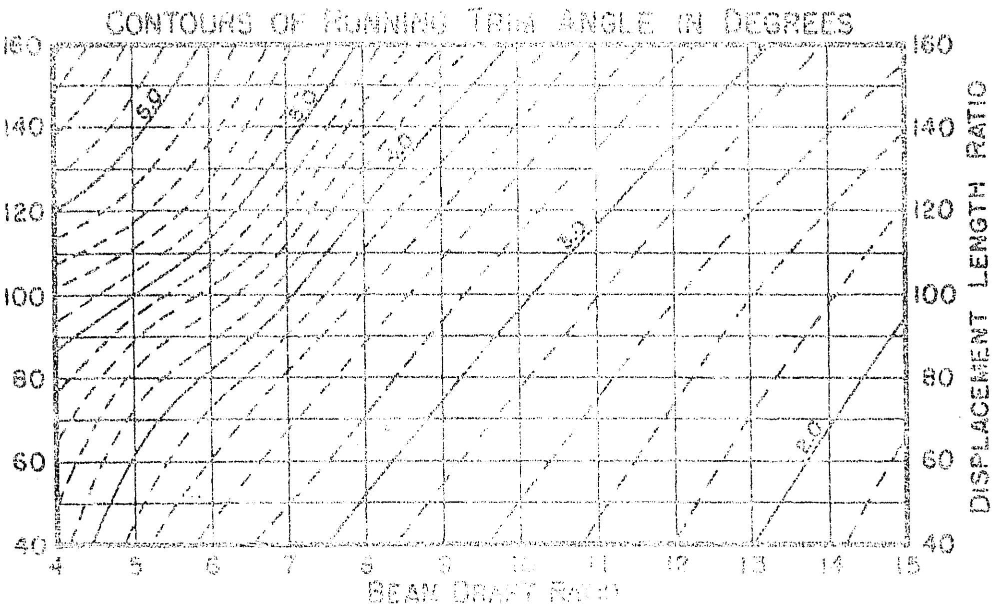
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 3.5$

$\Delta = N + 10\%$

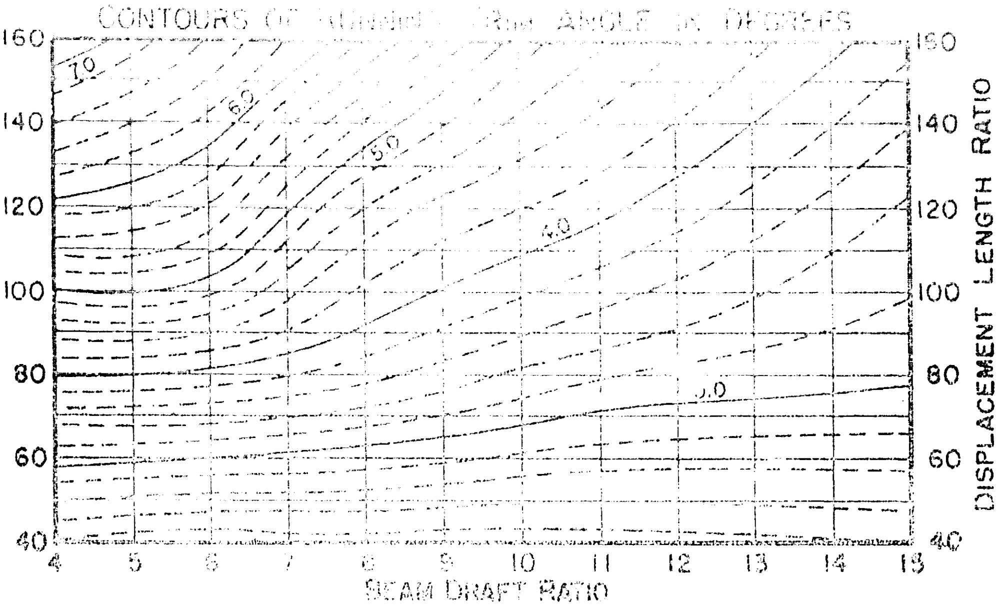
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 3.5$

$\Delta = N + 10\%$

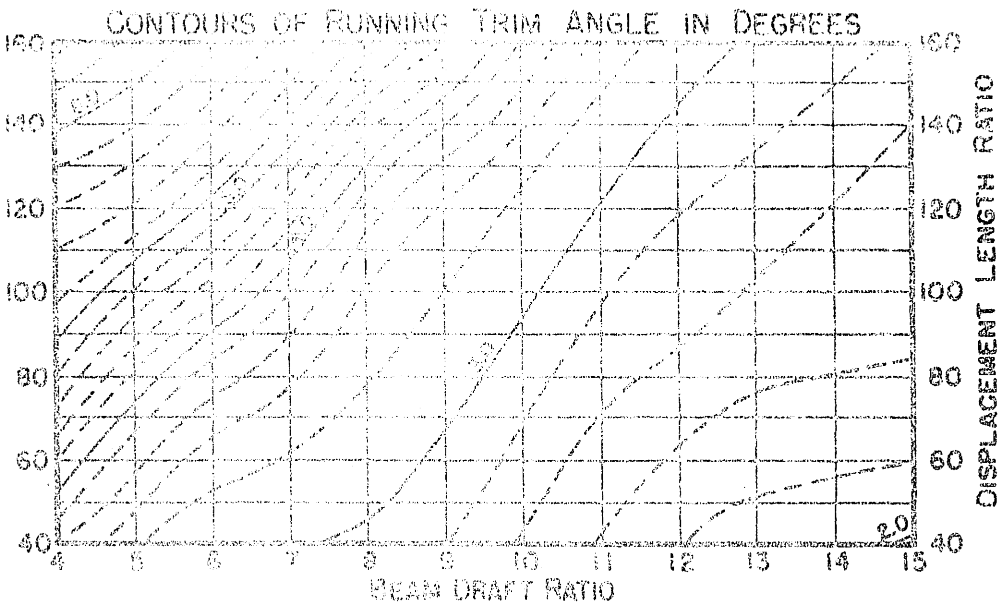
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 4.0$

Δ = N + 10%

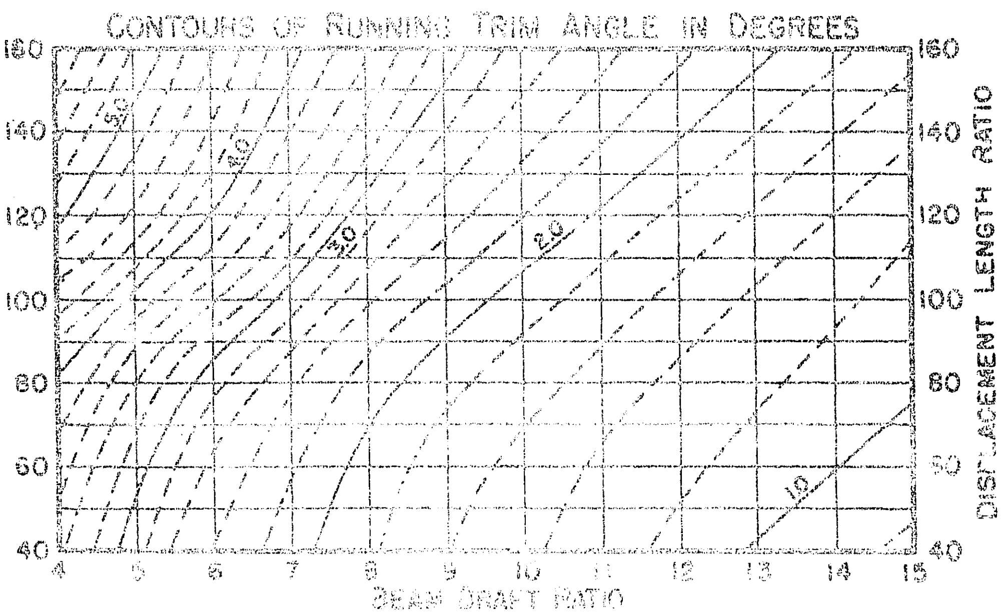
τ = 0°



$\frac{V}{\sqrt{L}} = 4.0$

Δ = N + 10%

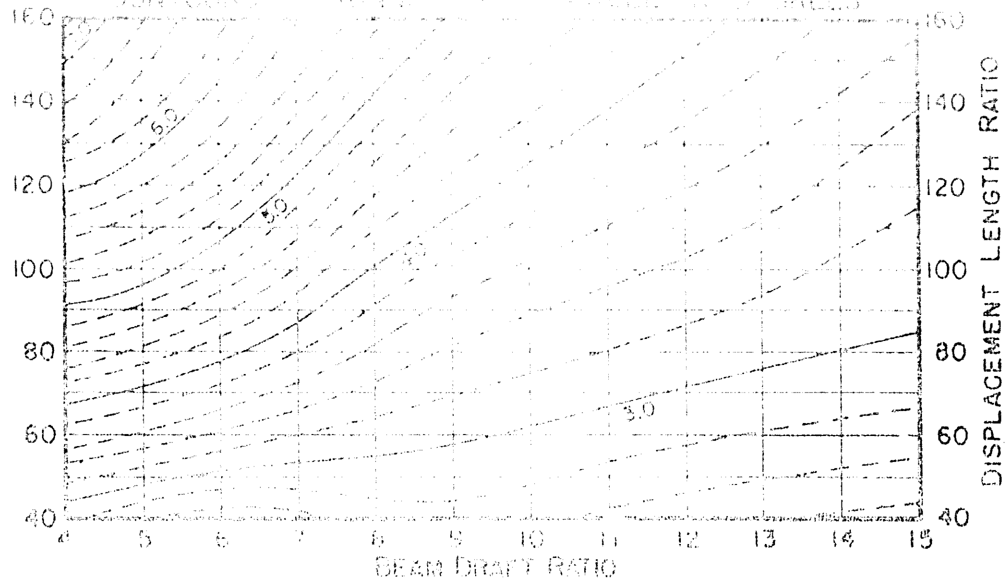
τ = 2°



$\frac{V}{\sqrt{L}} = 4.0$

Δ = N + 10%

τ = 4°

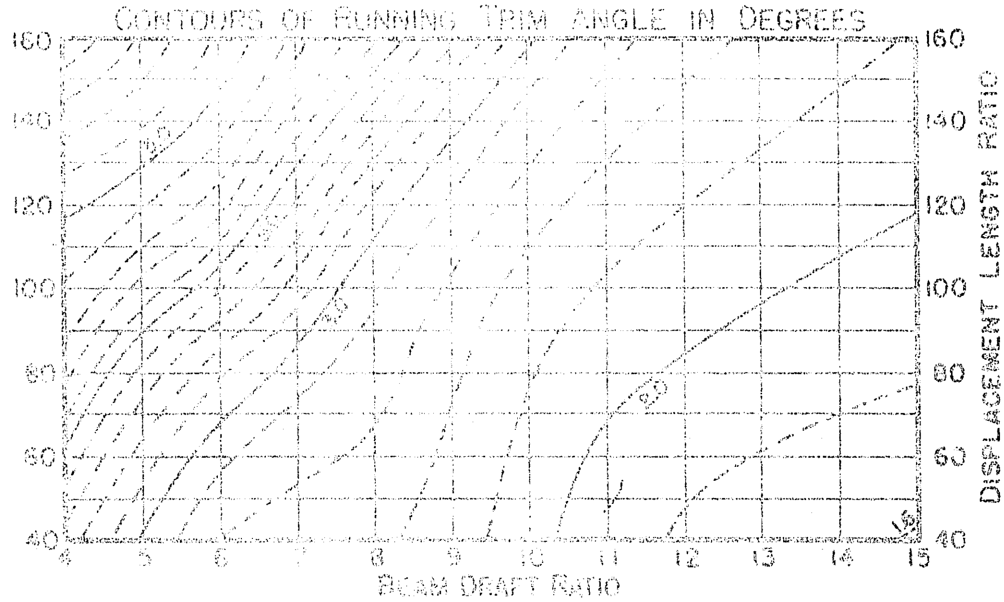


$\frac{V}{\sqrt{L}} = 4.5$

Δ = N + 10%

τ = 0°

CONTOURS OF RUNNING TRIM ANGLE IN DEGREES

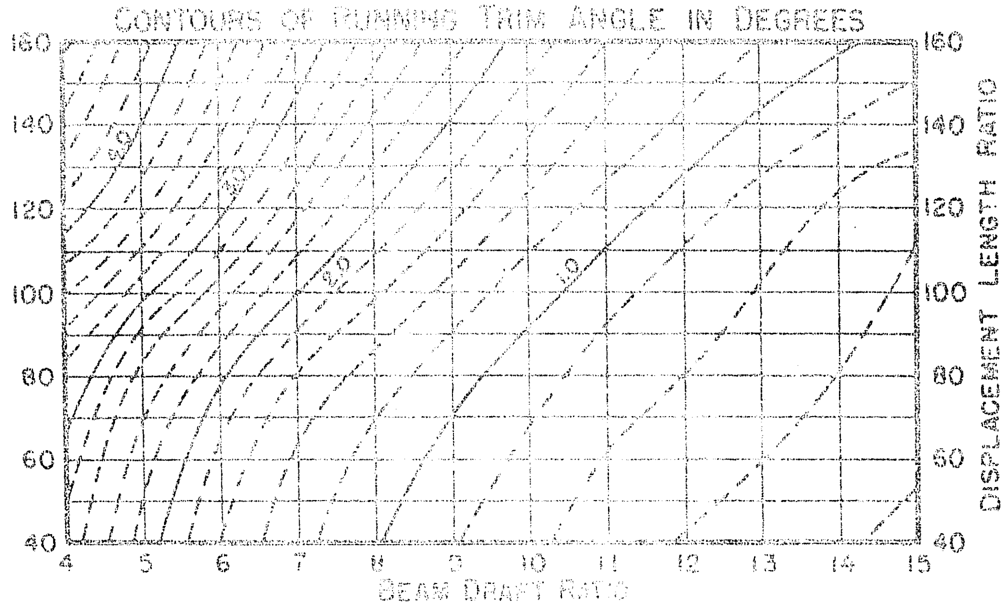


$\frac{V}{\sqrt{L}} = 4.5$

Δ = N + 10%

τ = 2°

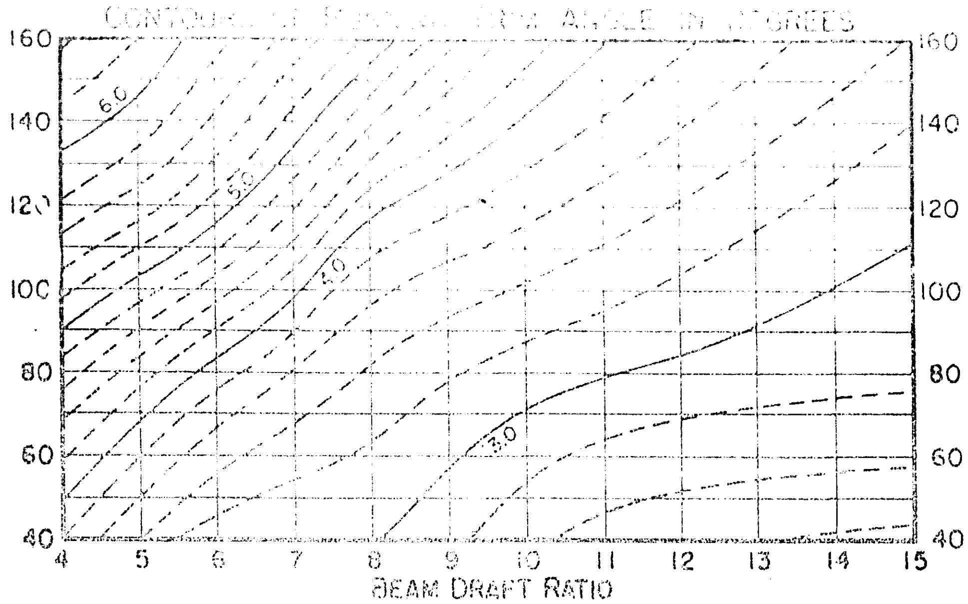
CONTOURS OF RUNNING TRIM ANGLE IN DEGREES



$\frac{V}{\sqrt{L}} = 4.5$

Δ = N + 10%

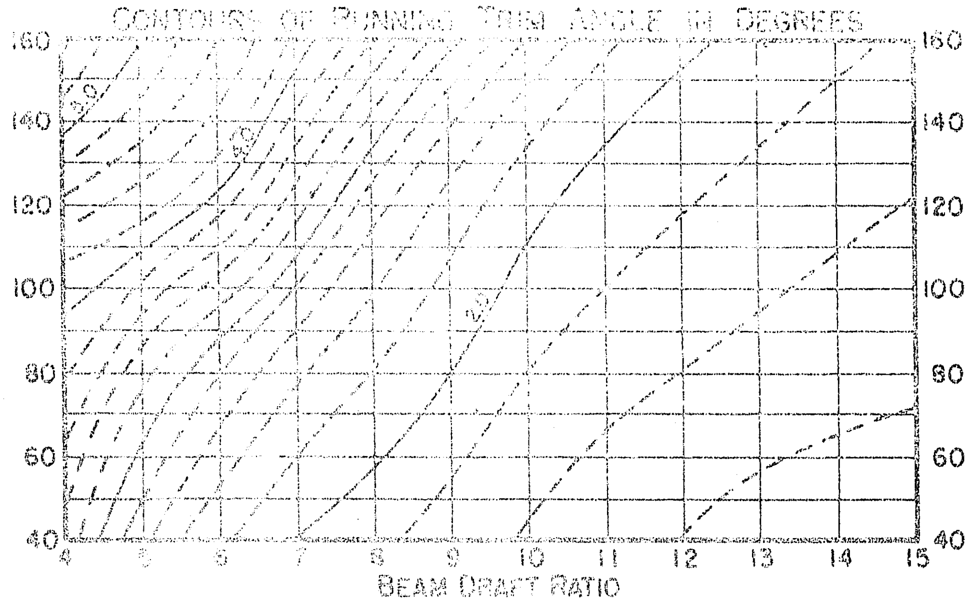
τ = 4°



$\frac{V}{\sqrt{L}} = 5.0$

$\Delta = N + 10\%$

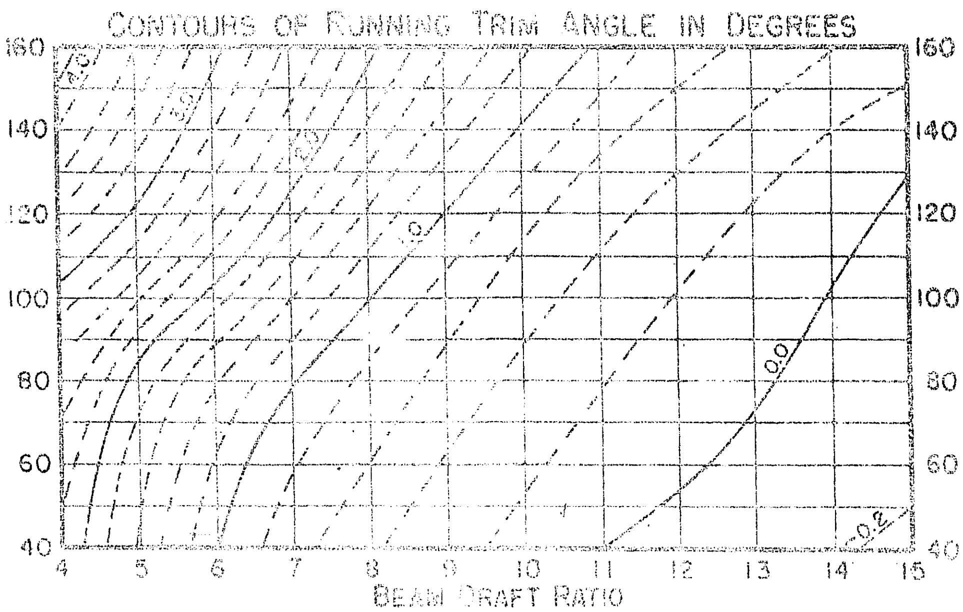
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 5.0$

$\Delta = N + 10\%$

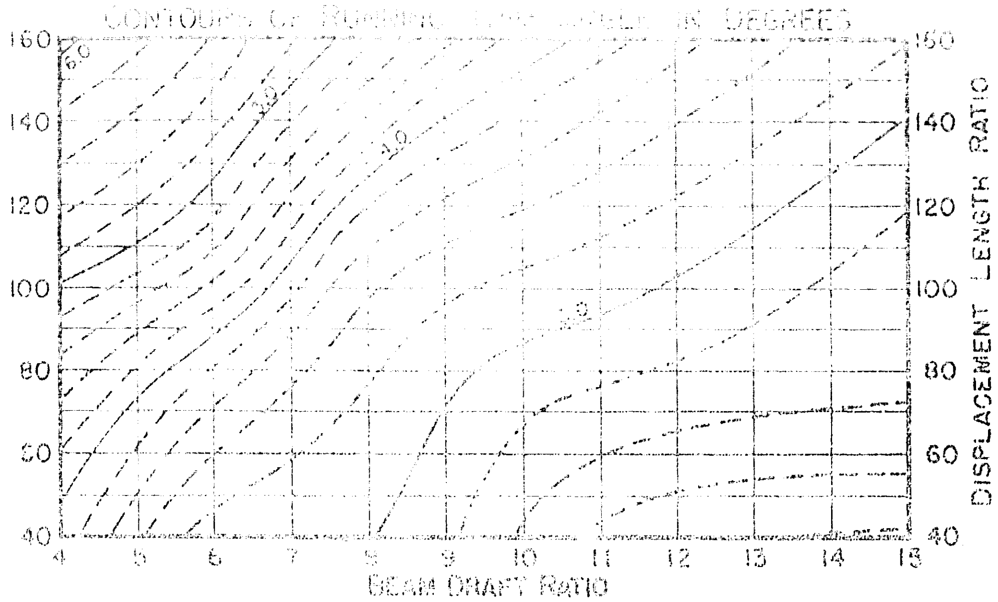
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 5.0$

$\Delta = N + 10\%$

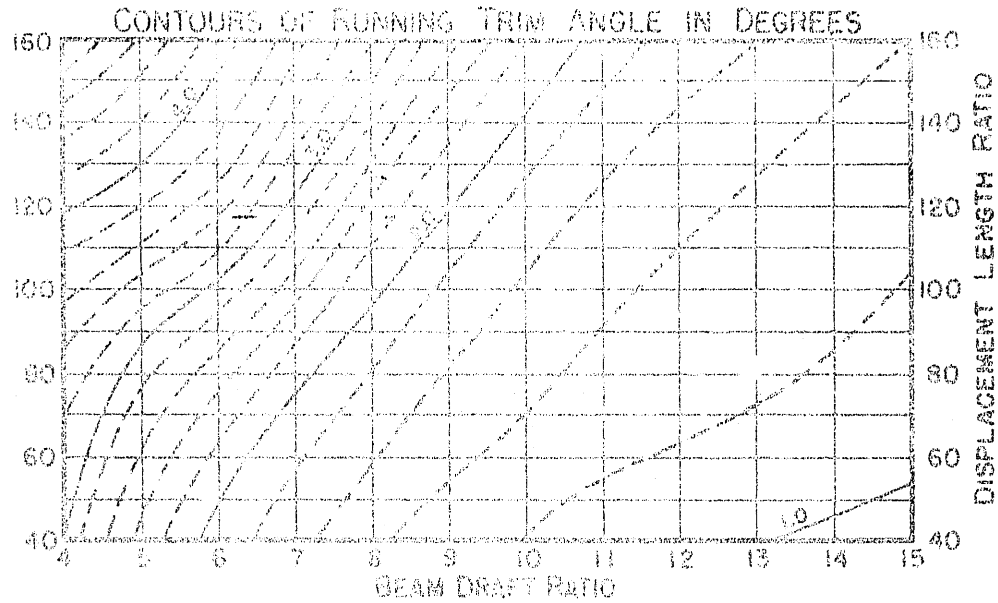
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N + 10\%$

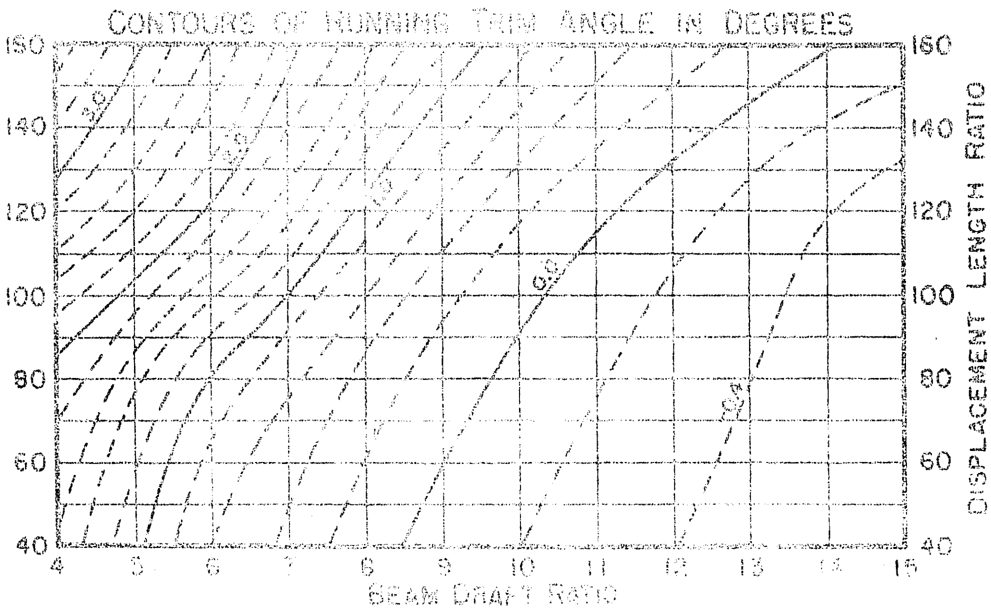
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N + 10\%$

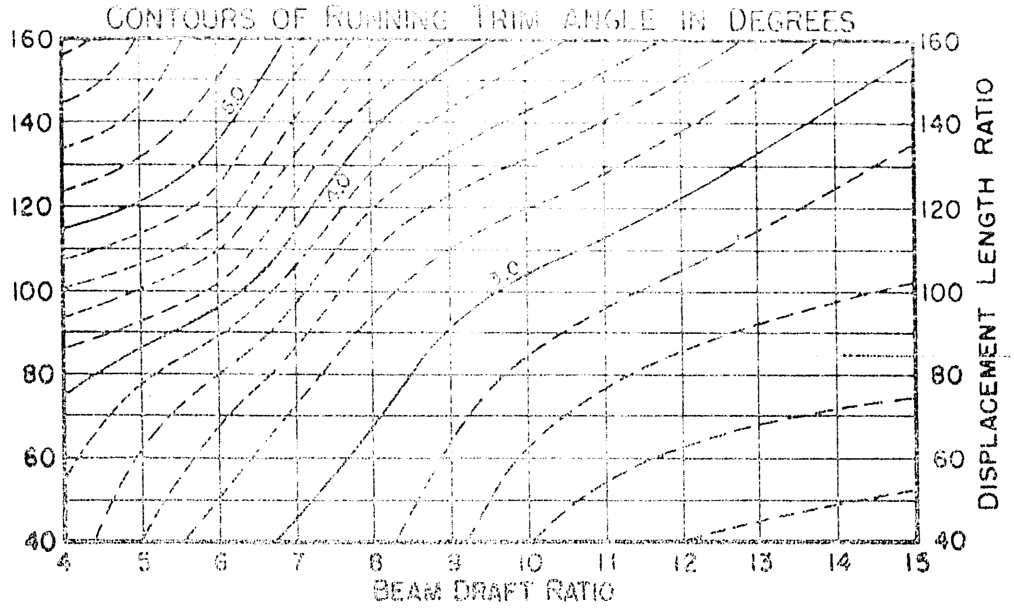
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N + 10\%$

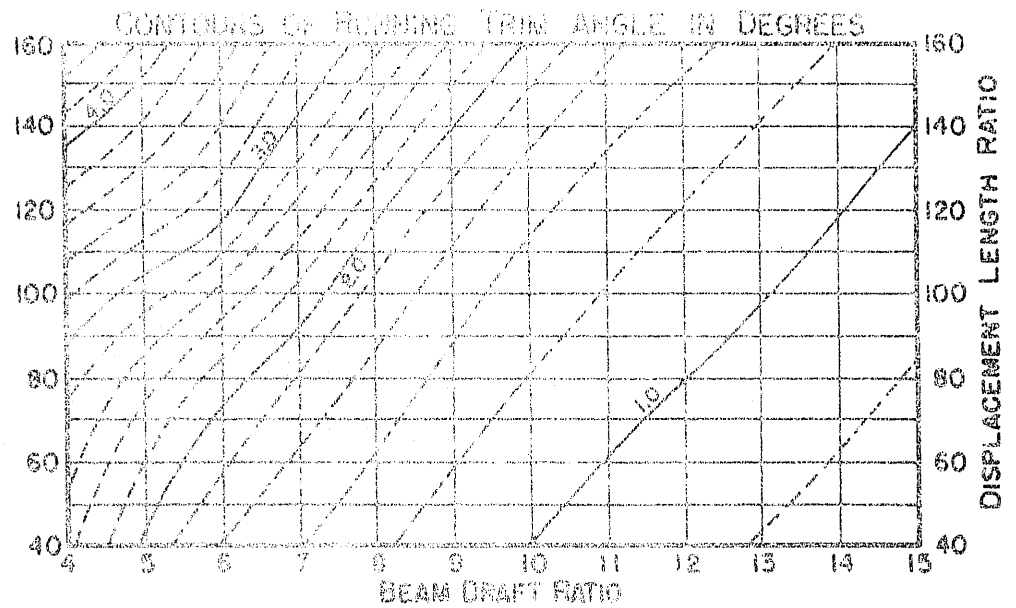
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 6.0$

Δ = N + 10%

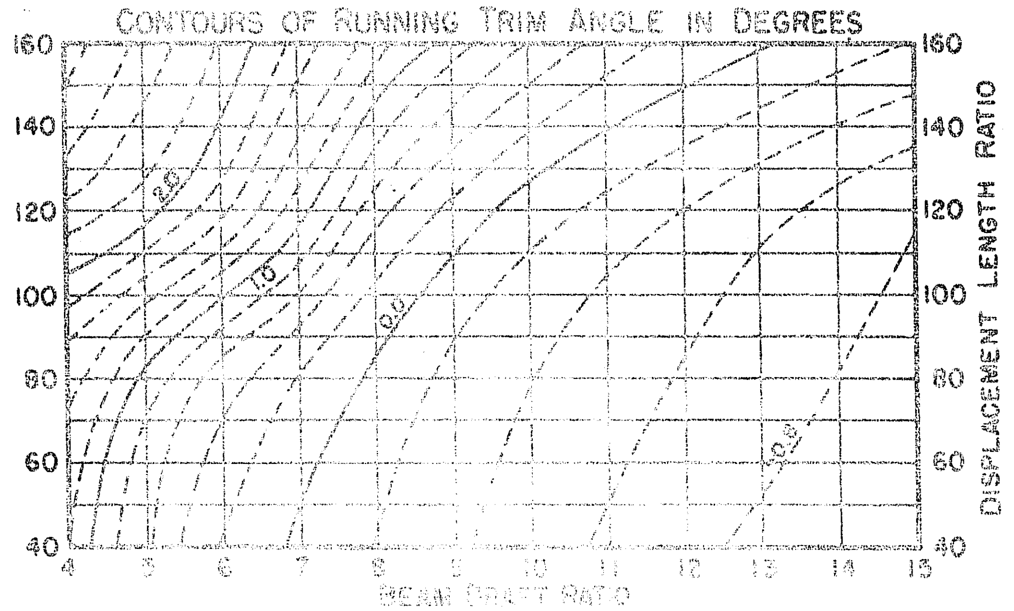
τ = 0°



$\frac{V}{\sqrt{L}} = 6.0$

Δ = N + 10%

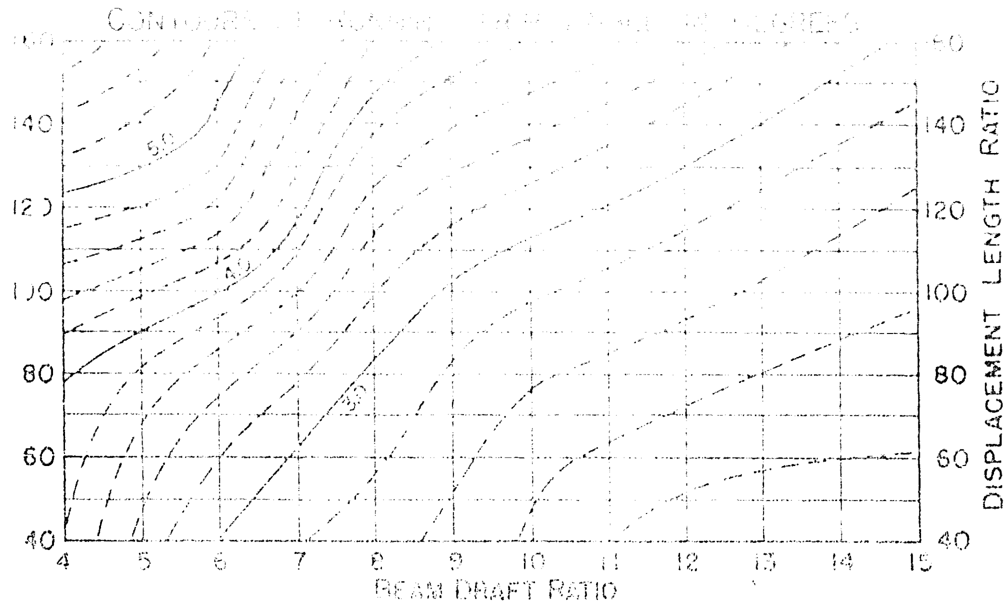
τ = 2°



$\frac{V}{\sqrt{L}} = 6.0$

Δ = N + 10%

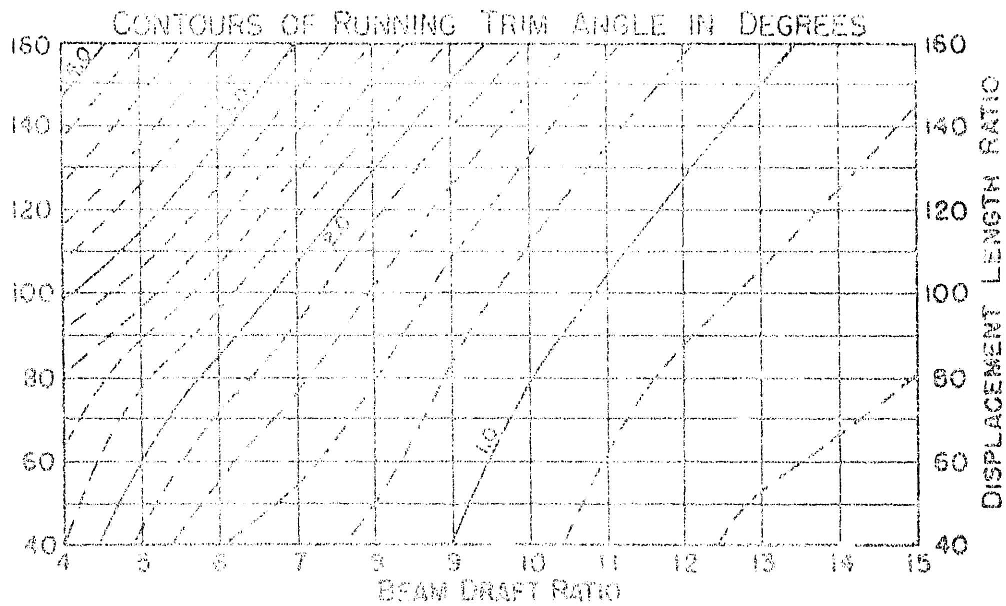
τ = 4°



$\frac{V}{\sqrt{L}} = 6.5$

Δ = N + 10%

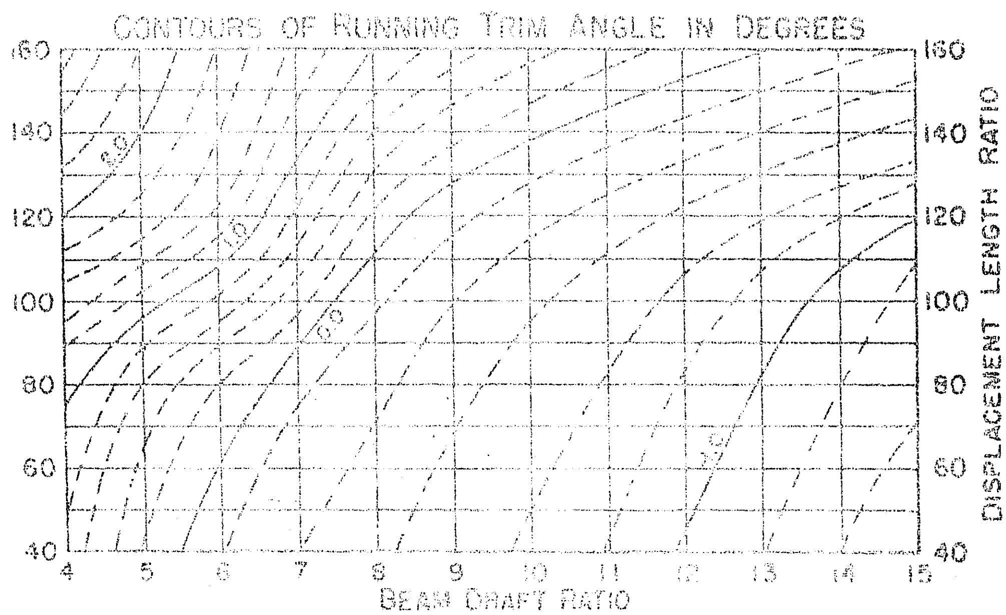
τ = 0°



$\frac{V}{\sqrt{L}} = 6.5$

Δ = N + 10%

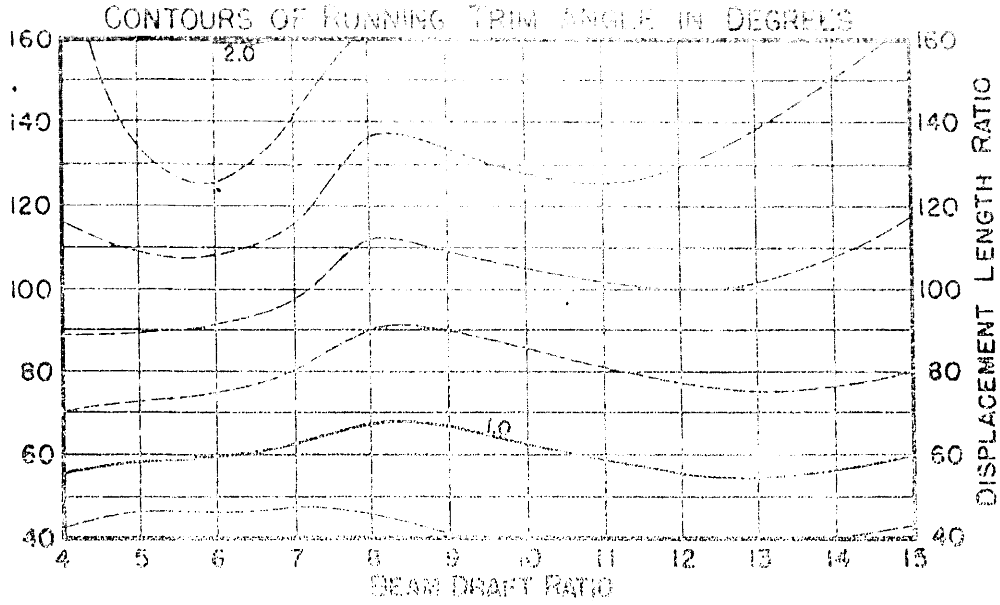
τ = 2°



$\frac{V}{\sqrt{L}} = 6.5$

Δ = N + 10%

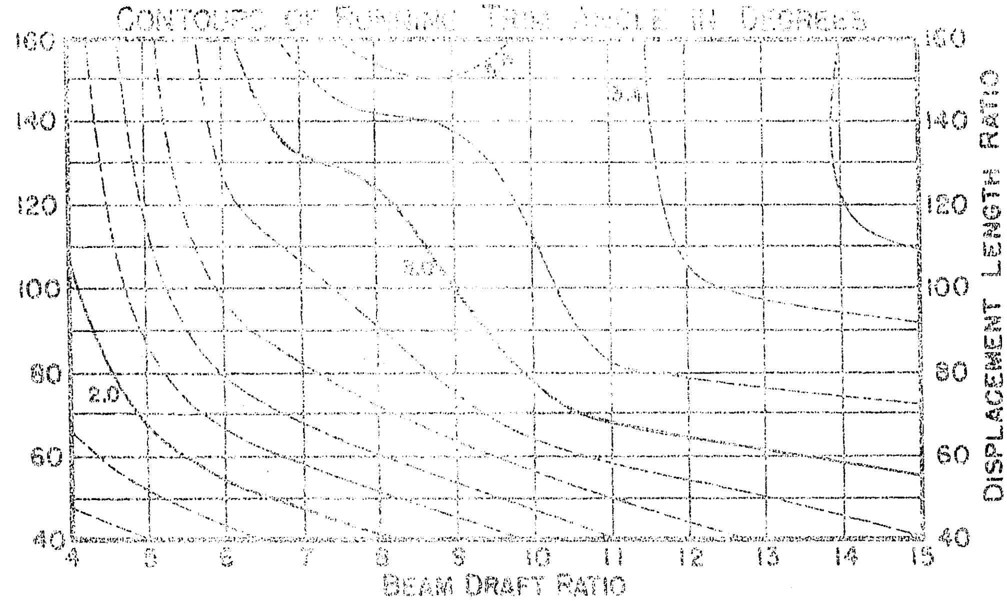
τ = 4°



$\frac{V}{\sqrt{L}} = 1.5$

Δ = N + 20%

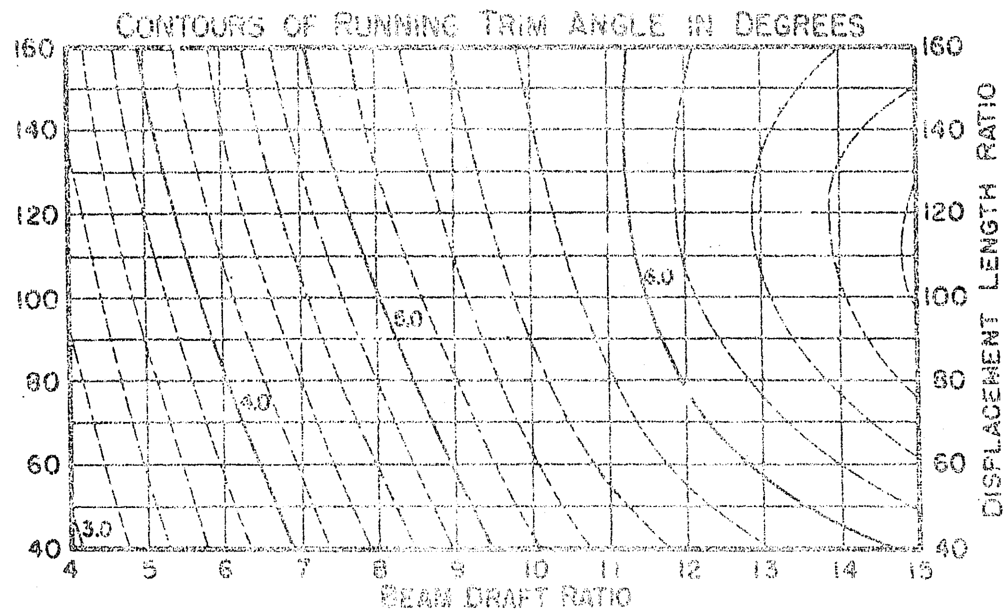
τ = 0°



$\frac{V}{\sqrt{L}} = 1.5$

Δ = N + 20%

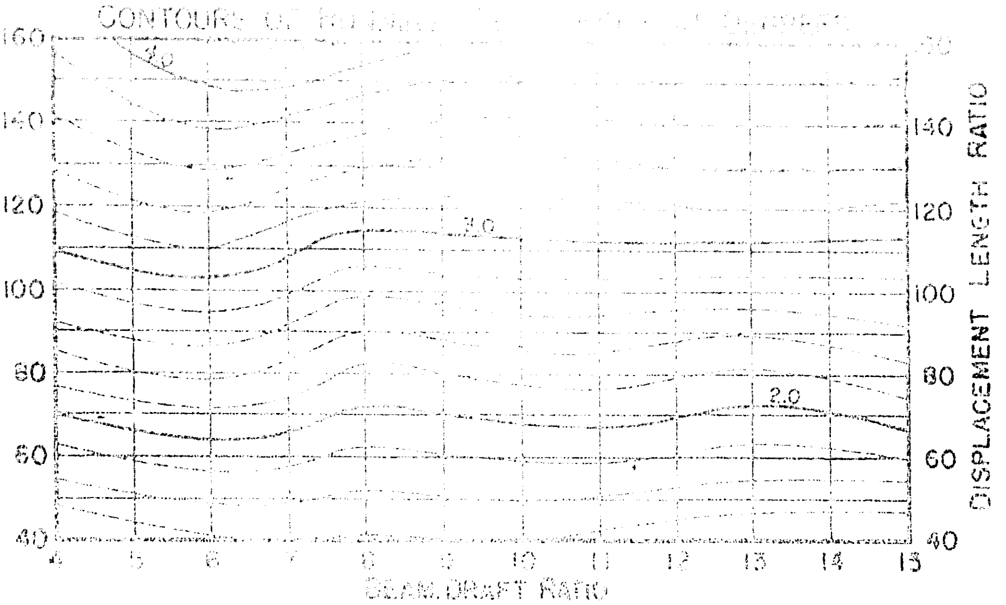
τ = 2°



$\frac{V}{\sqrt{L}} = 1.5$

Δ = N + 20%

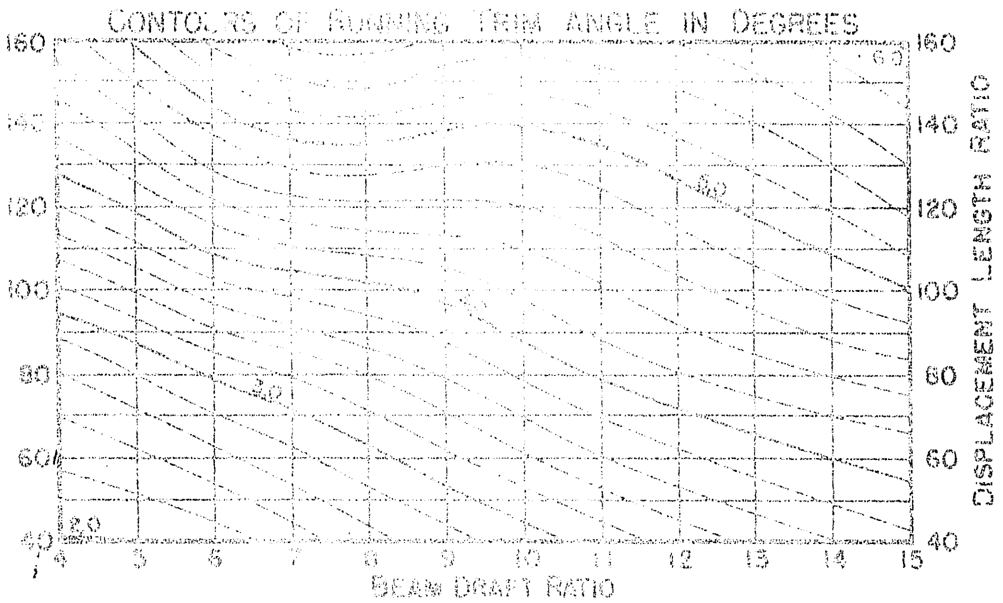
τ = 4°



$\frac{V}{\sqrt{L}} = 2.0$

$\Delta = N + 20\%$

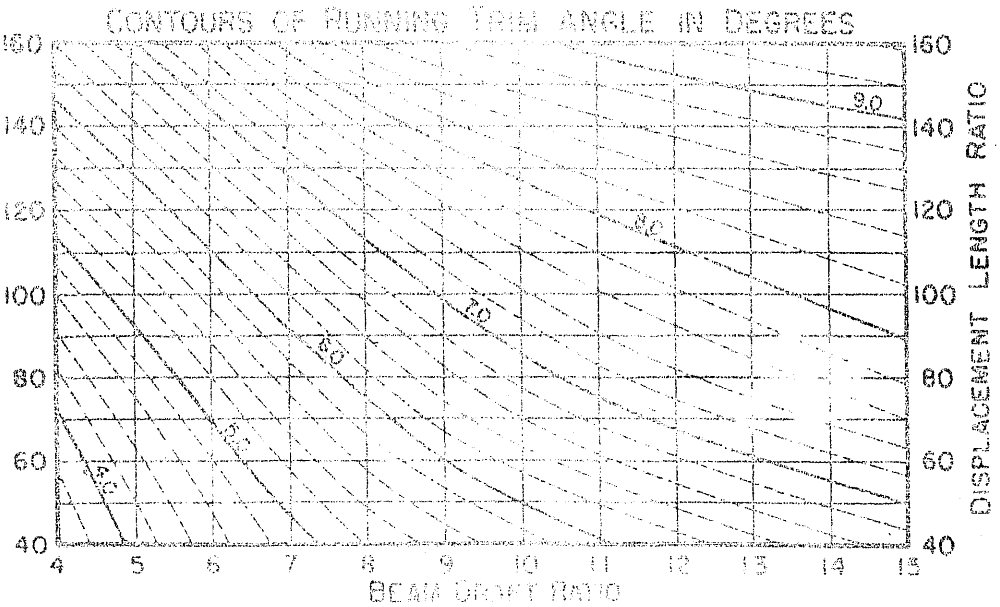
$\tau = 0$



$\frac{V}{\sqrt{L}} = 2.0$

$\Delta = N + 20\%$

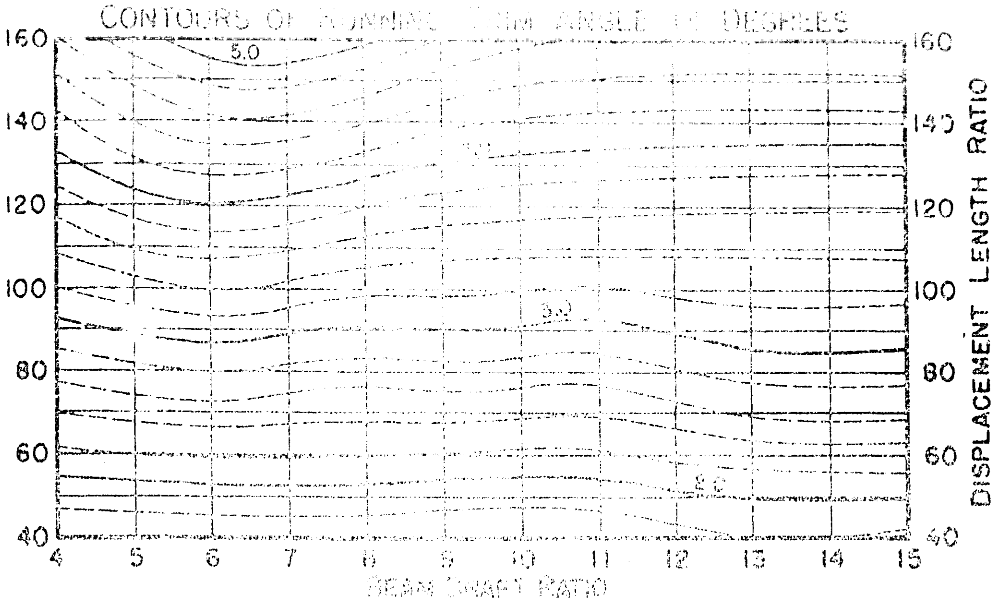
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 2.0$

$\Delta = N + 20\%$

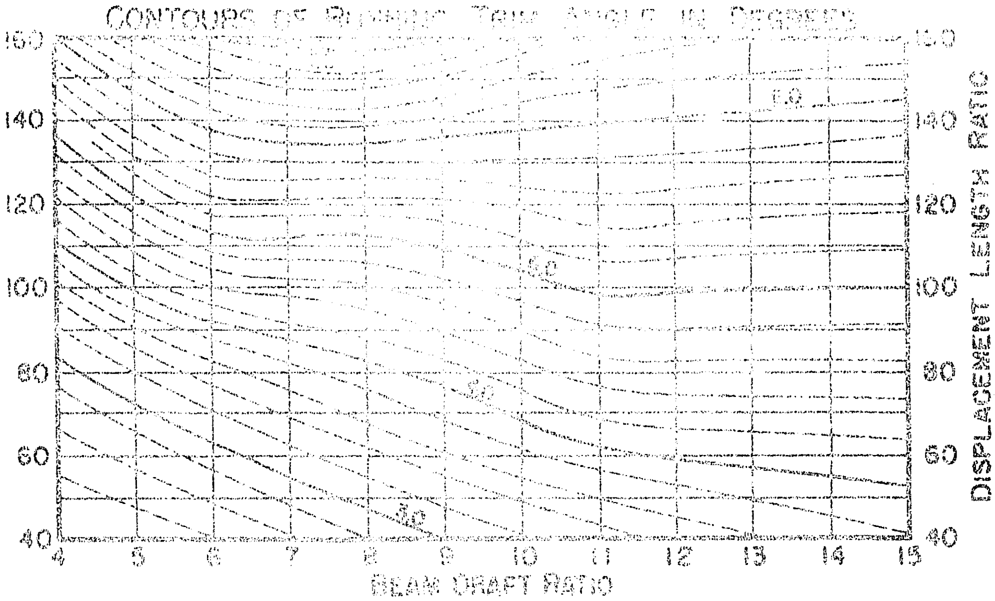
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 2.5$

$\Delta = N + 20\%$

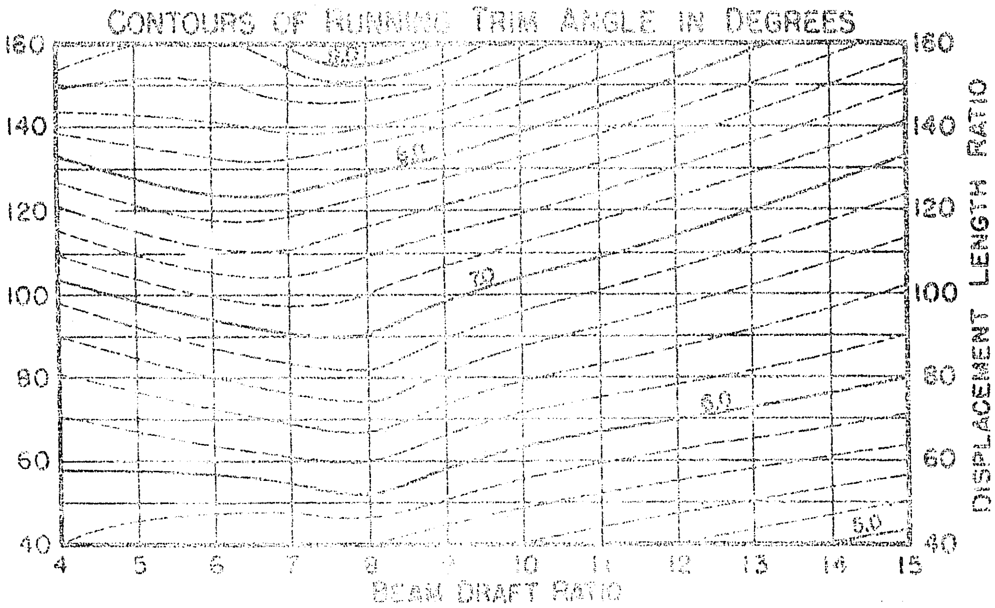
$\mathcal{T} = 0°$



$\frac{V}{\sqrt{L}} = 2.5$

$\Delta = N + 20\%$

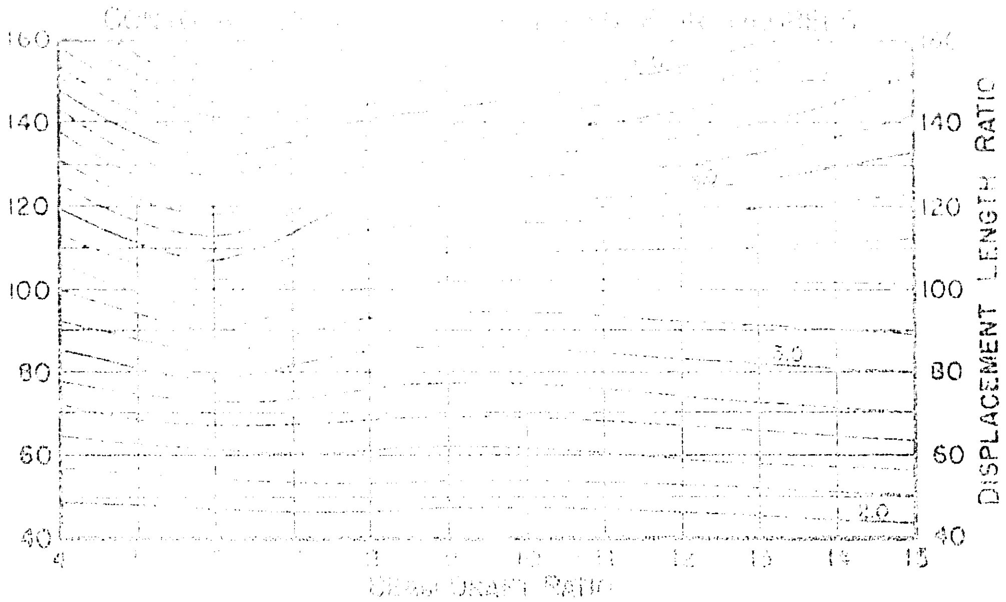
$\mathcal{T} = 2°$



$\frac{V}{\sqrt{L}} = 2.5$

$\Delta = N + 20\%$

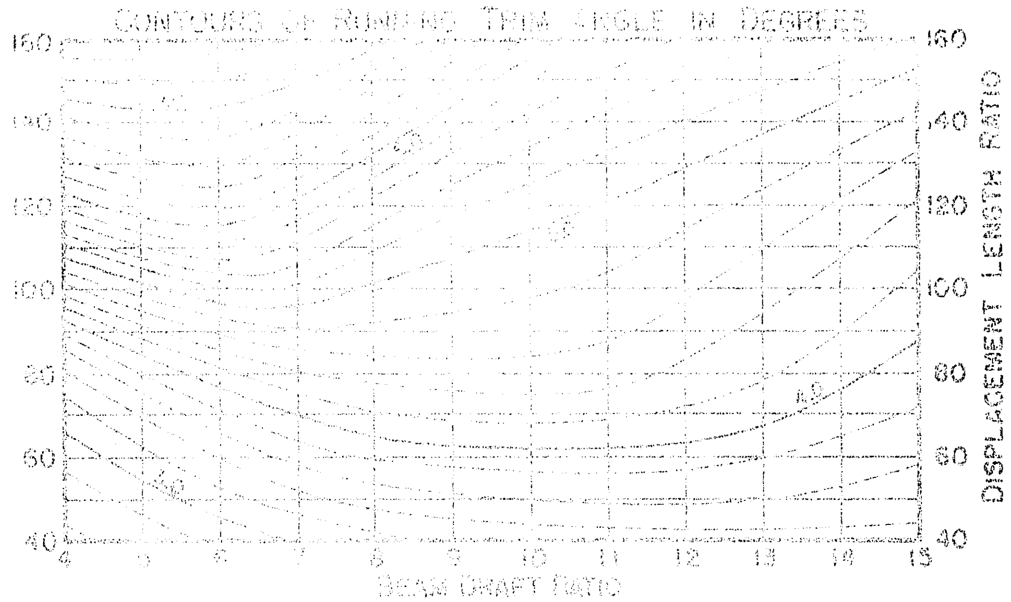
$\mathcal{T} = 4°$



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 20\%$

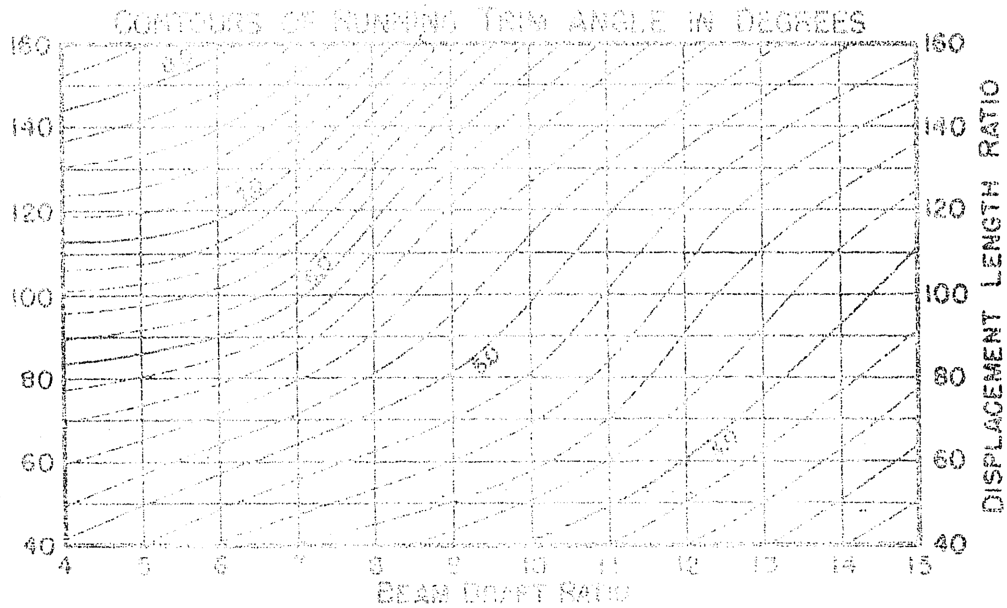
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 20\%$

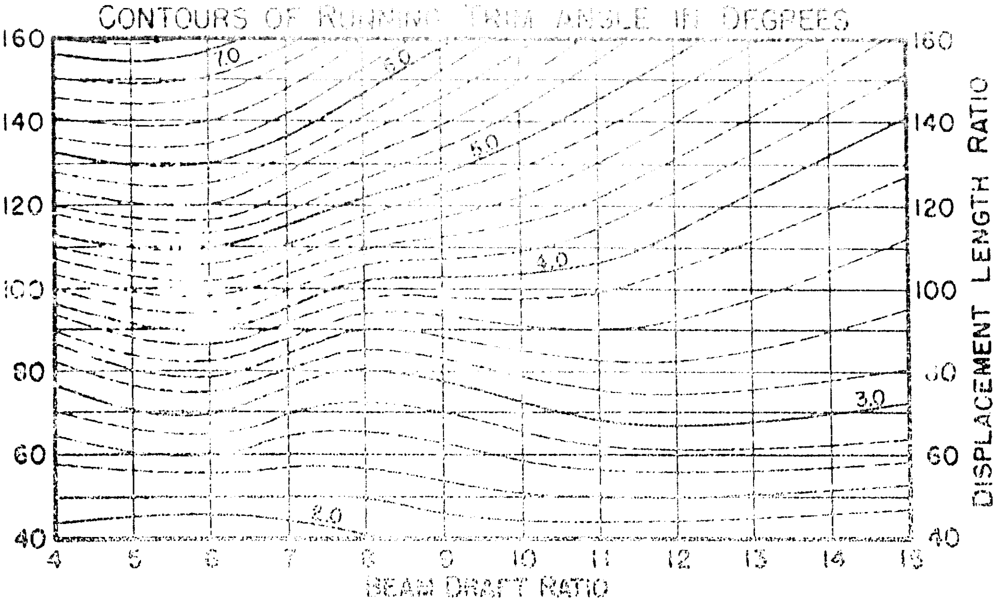
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 20\%$

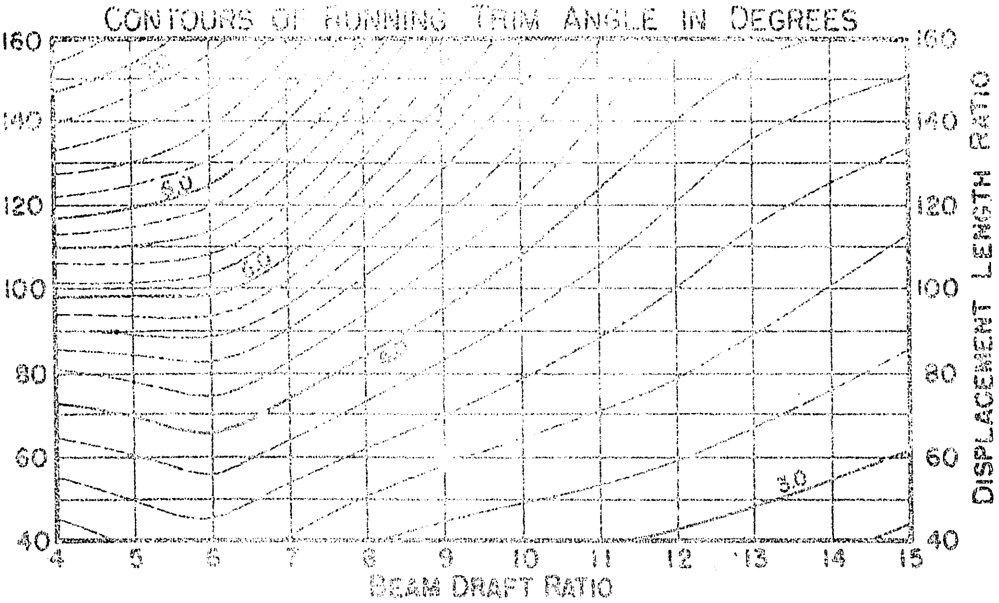
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 3.5$

$\Delta = N + 20\%$

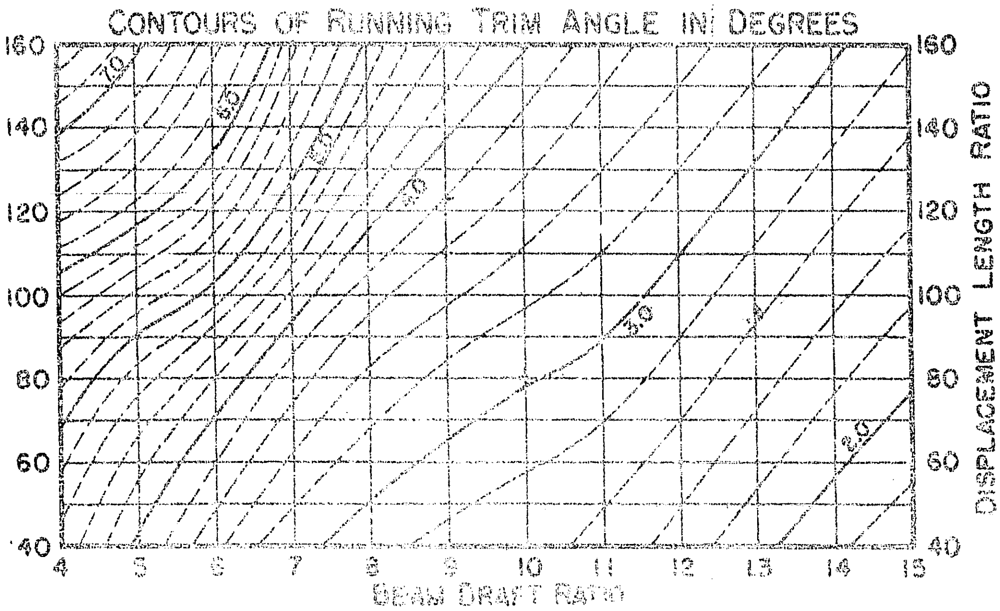
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 3.5$

$\Delta = N + 20\%$

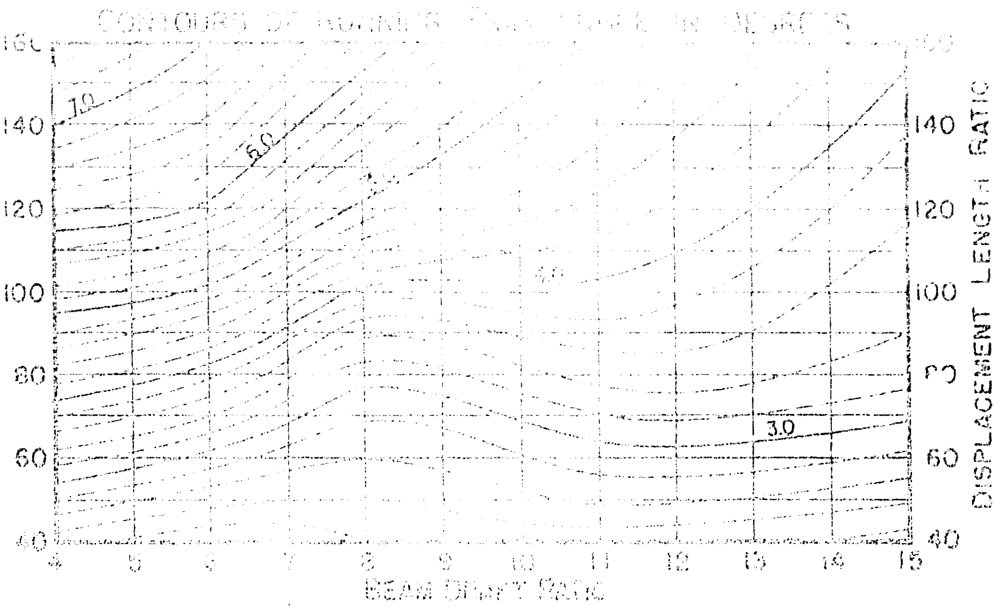
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 3.5$

$\Delta = N + 20\%$

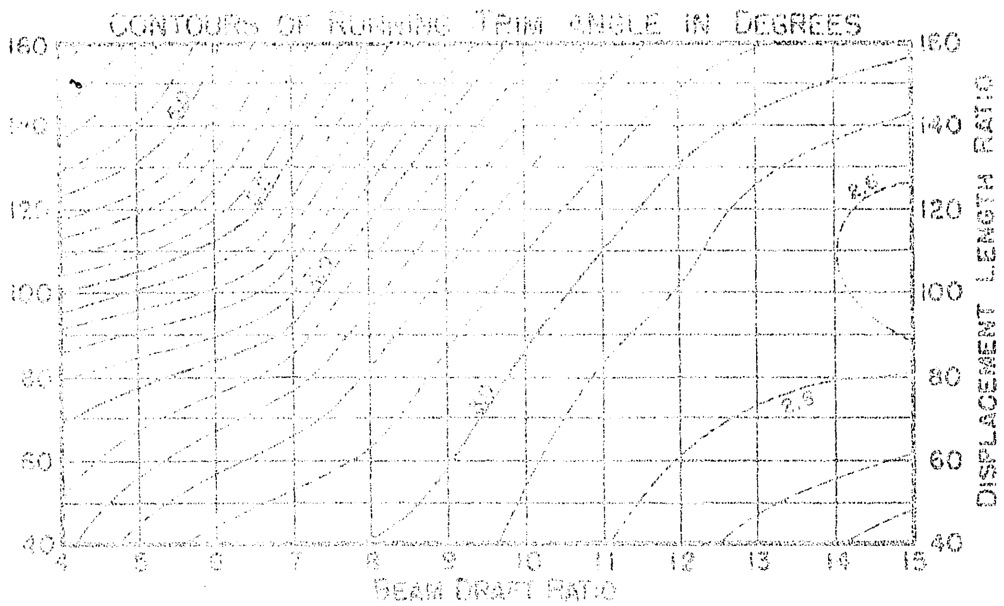
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 4.0$

Δ = N + 20%

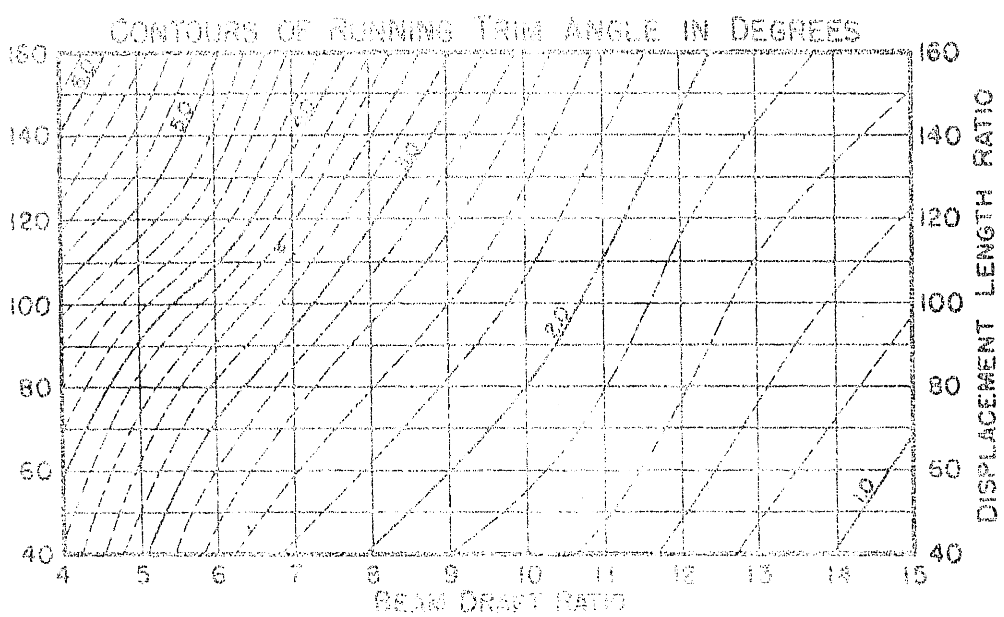
τ = 0°



$\frac{V}{\sqrt{L}} = 4.0$

Δ = N + 20%

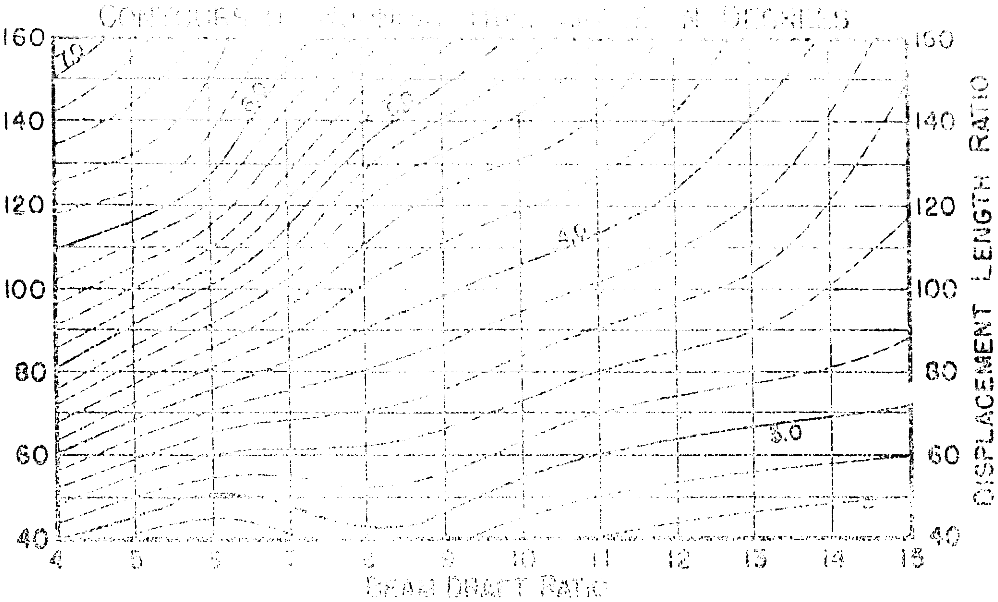
τ = 2°



$\frac{V}{\sqrt{L}} = 4.0$

Δ = N + 20%

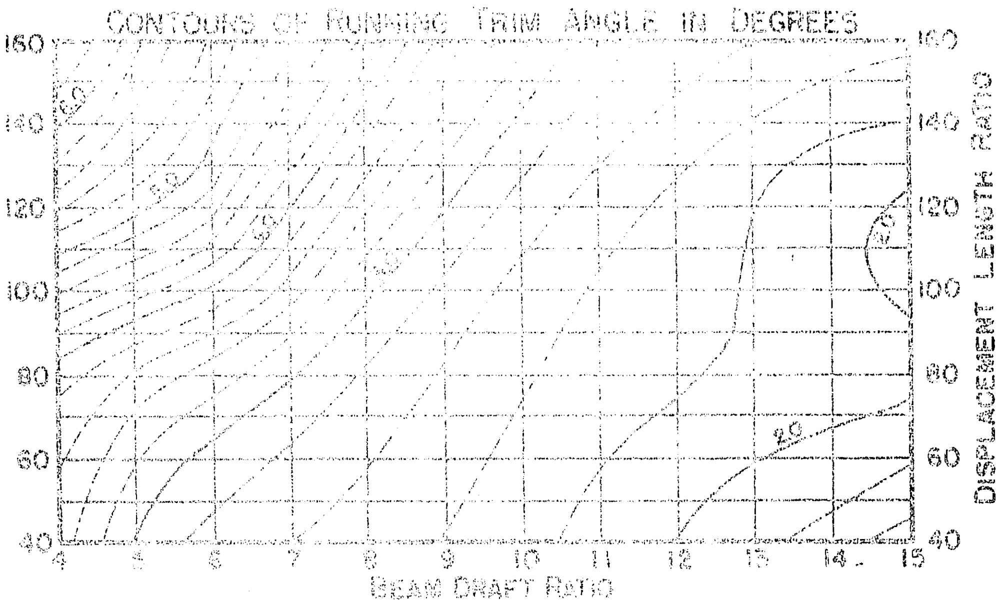
τ = 4°



$\frac{V}{\sqrt{L}} = 4.5$

Δ = N + 20%

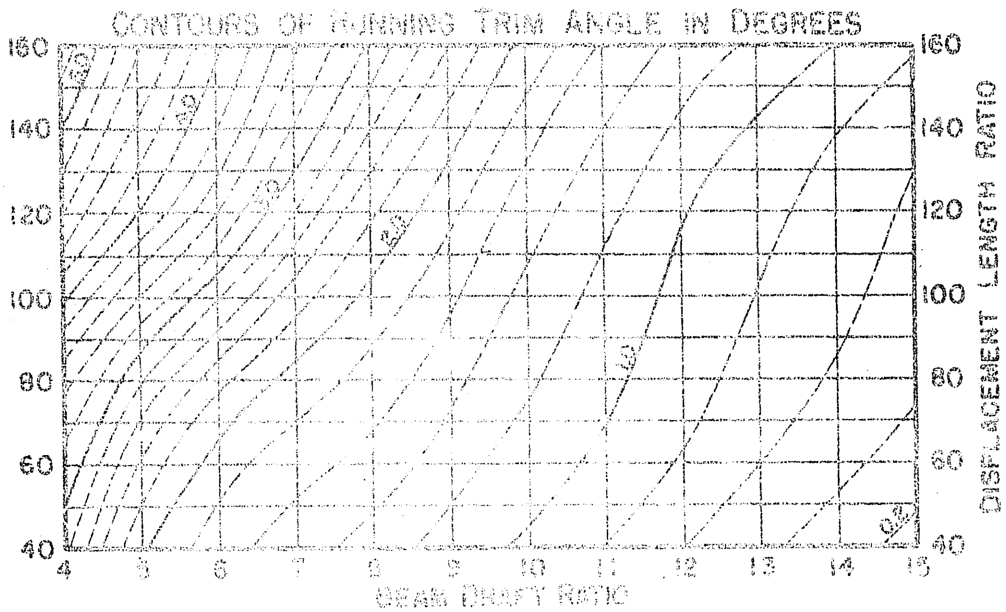
τ = 0°



$\frac{V}{\sqrt{L}} = 4.5$

Δ = N + 20%

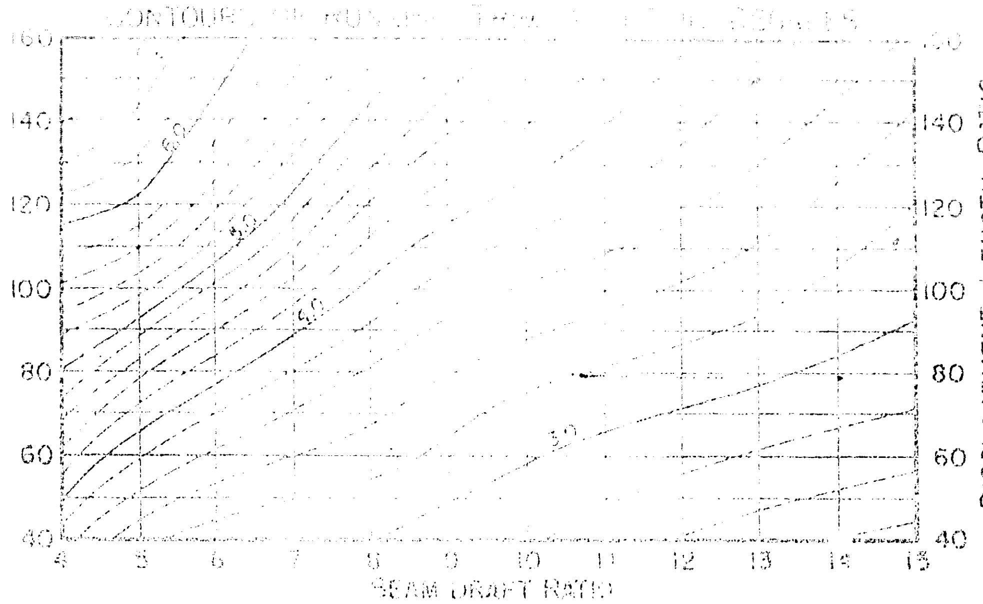
τ = 2°



$\frac{V}{\sqrt{L}} = 4.5$

Δ = N + 20%

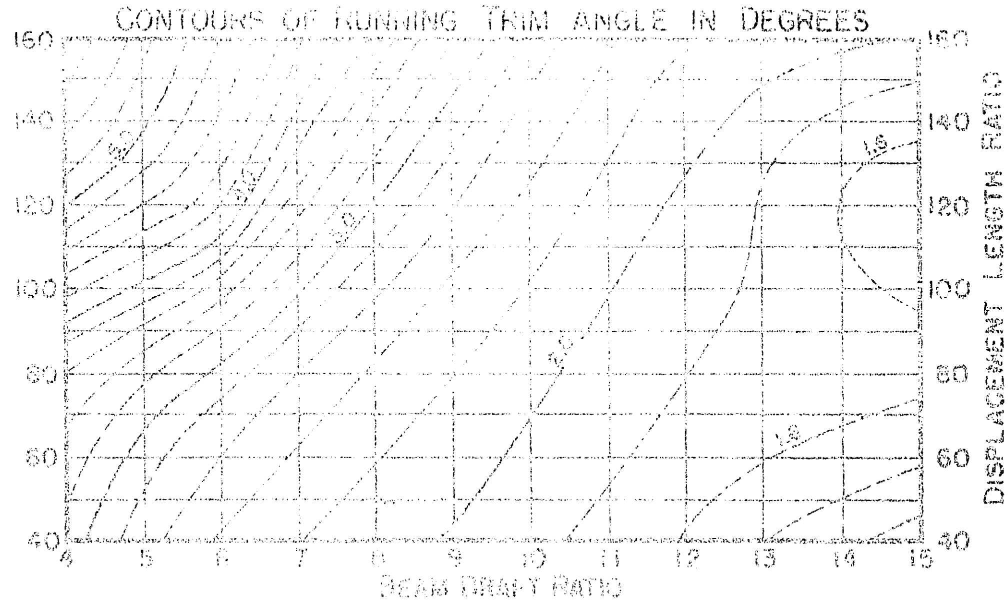
τ = 4°



$\frac{V}{\sqrt{L}} = 5.0$

$\Delta = N + 20\%$

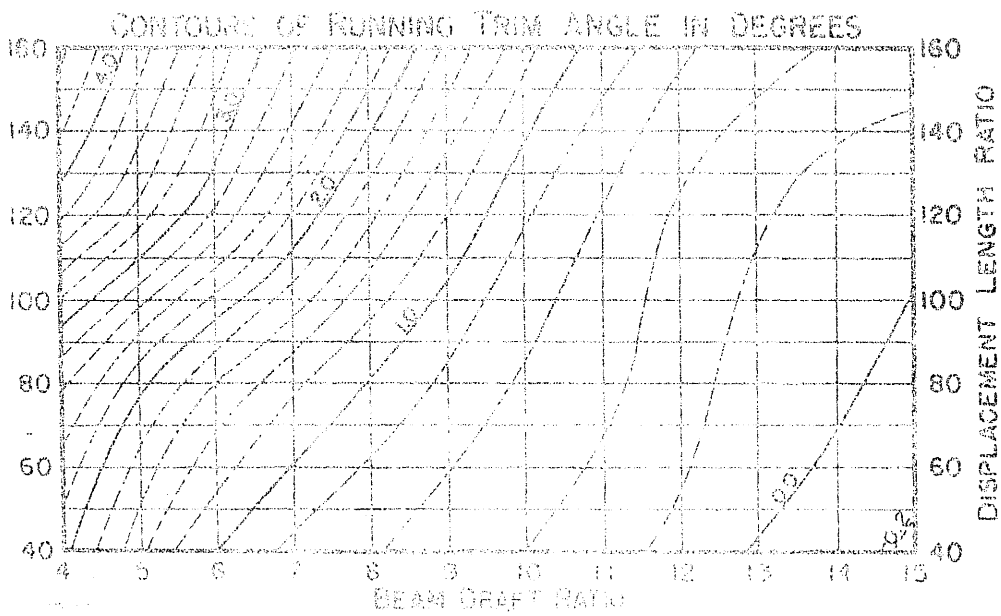
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 5.0$

$\Delta = N + 20\%$

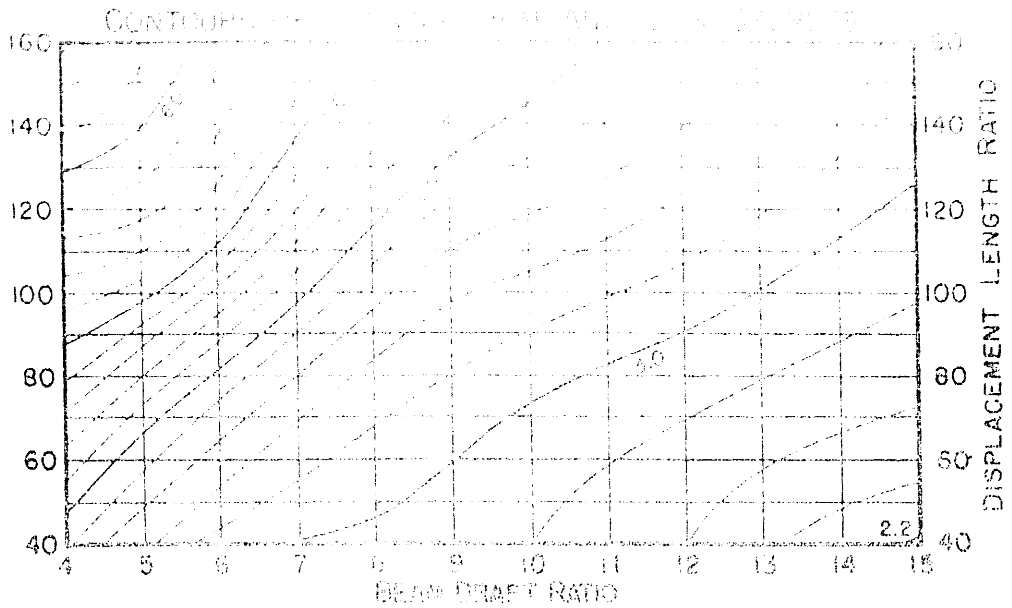
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 5.0$

$\Delta = N + 20\%$

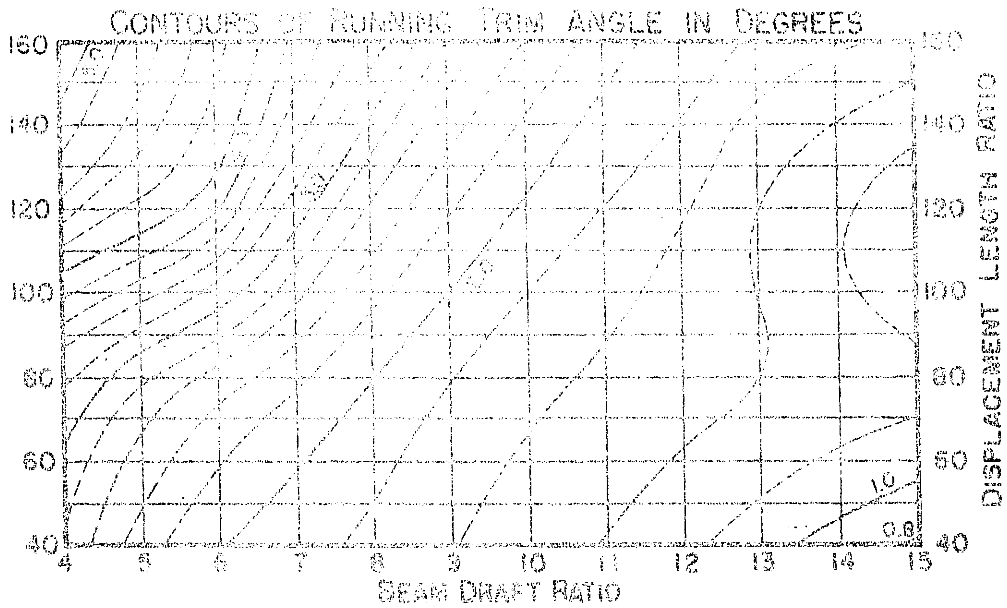
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N + 20\%$

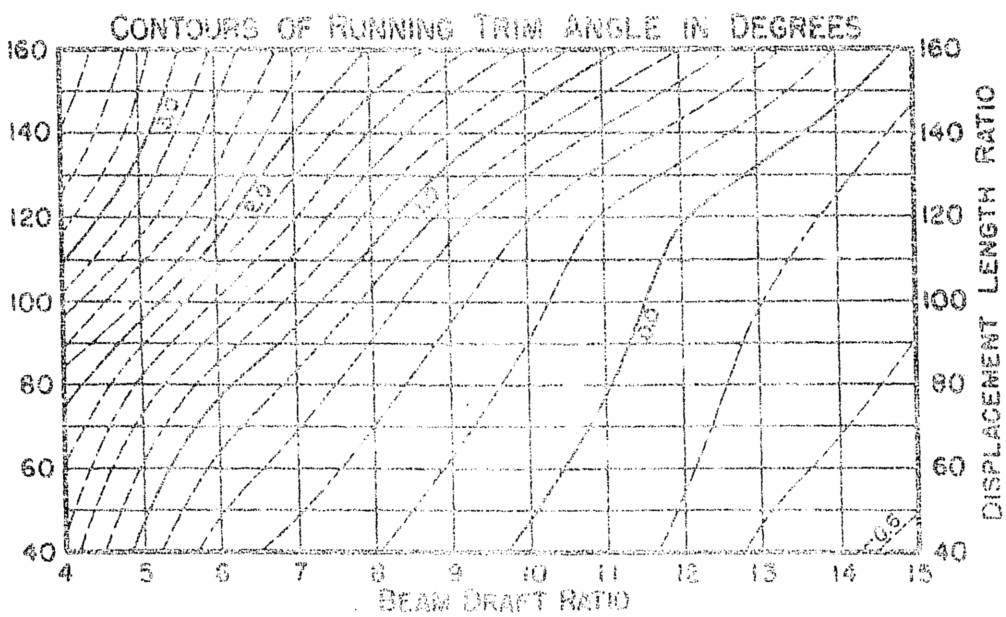
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N + 20\%$

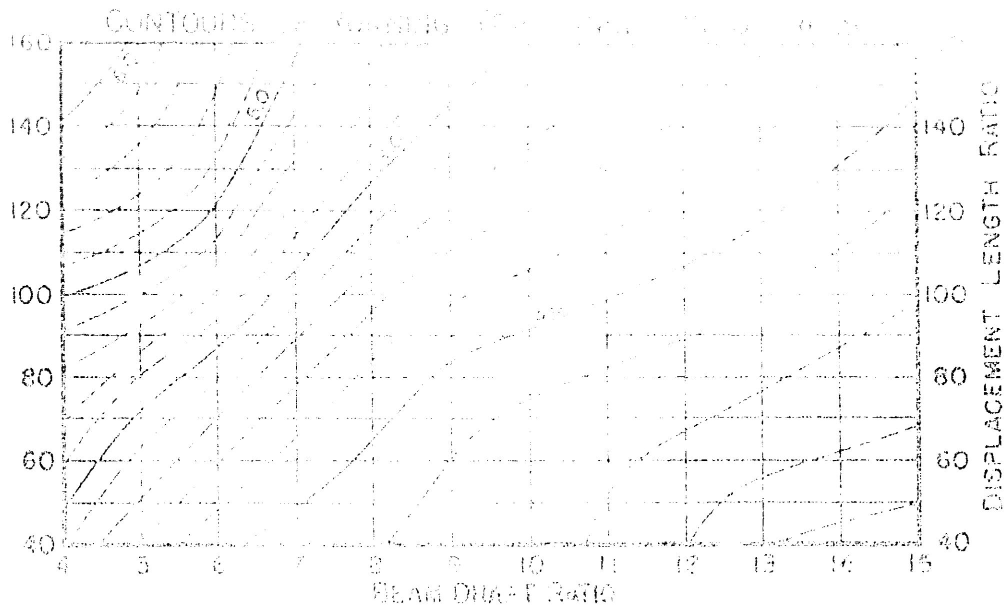
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 5.5$

$\Delta = N + 20\%$

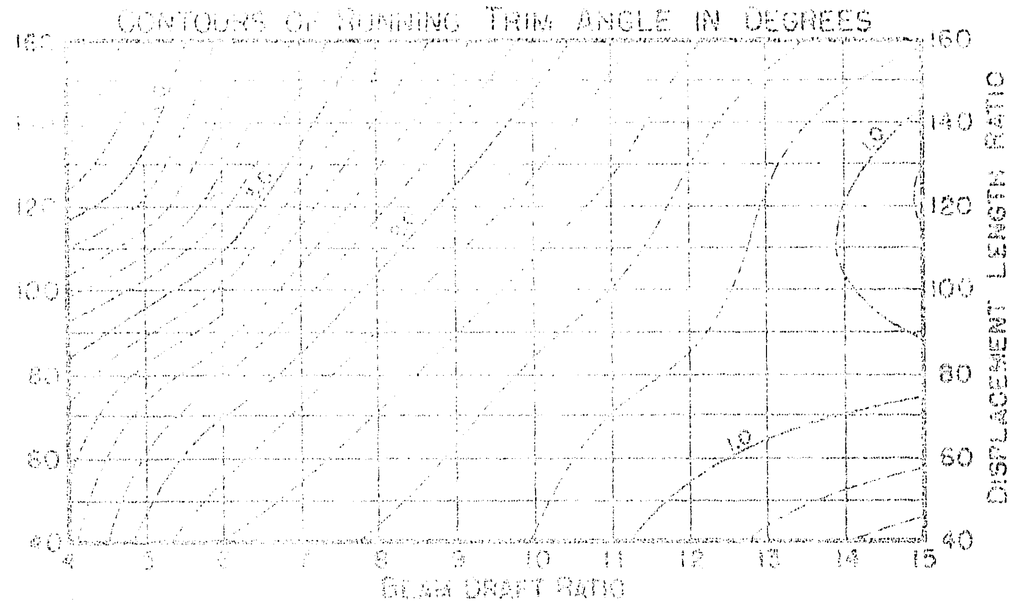
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 6.0$

$\Delta = N + 20\%$

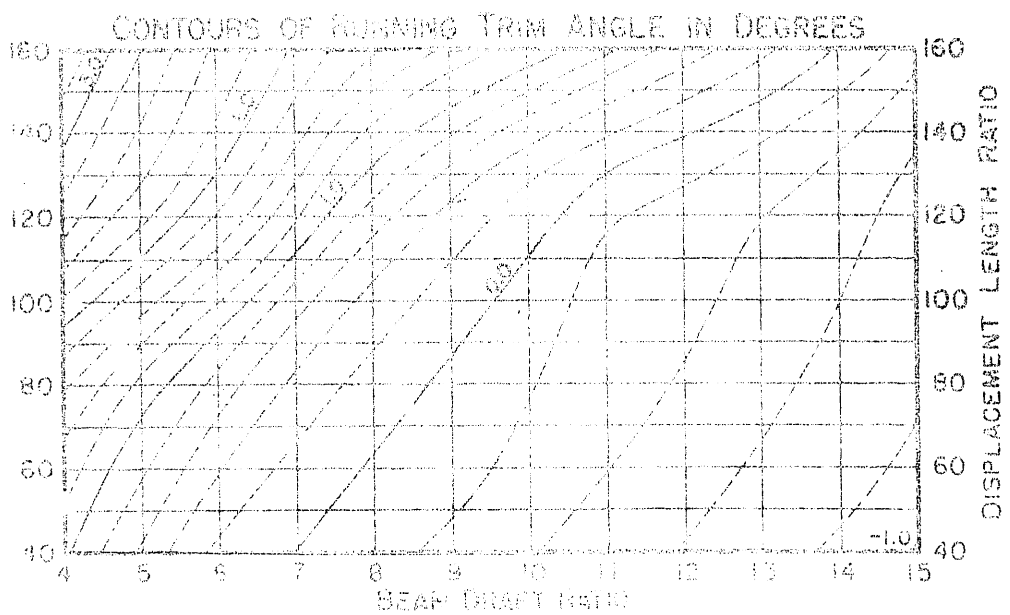
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 6.0$

$\Delta = N + 20\%$

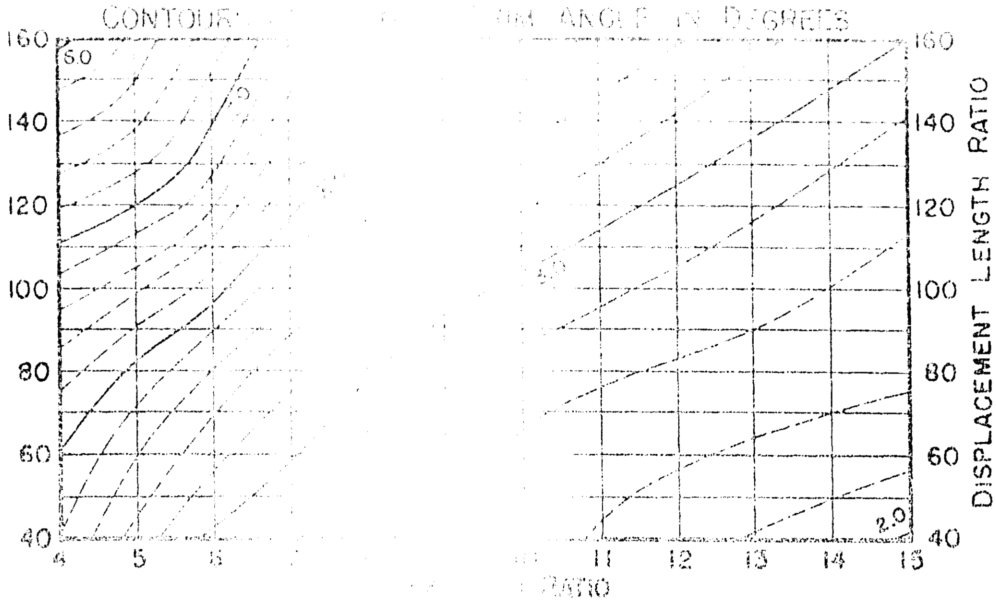
$\tau = 2°$



$\frac{V}{\sqrt{L}} = 6.0$

$\Delta = N + 20\%$

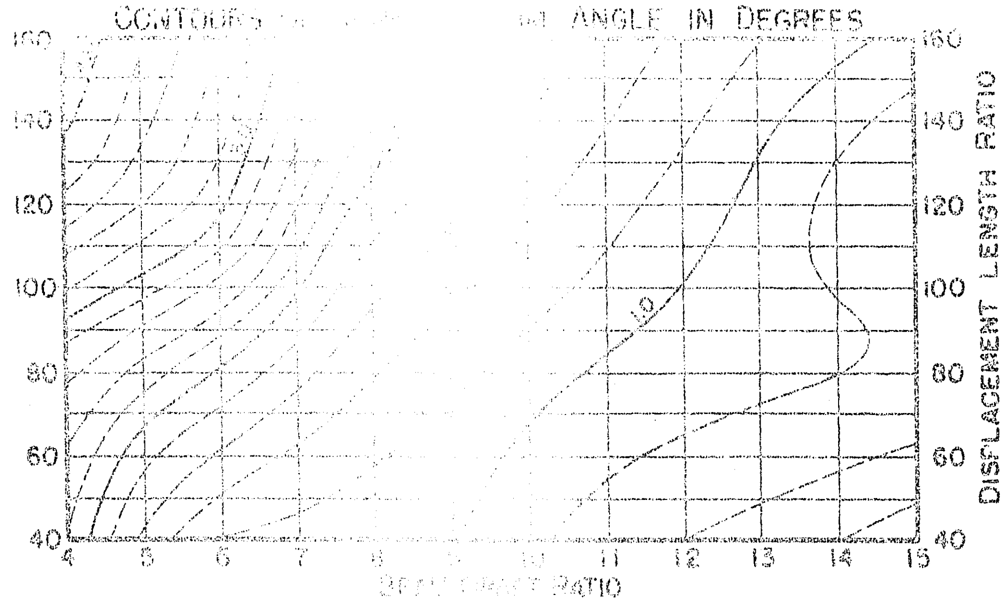
$\tau = 4°$



$\frac{V}{\sqrt{L}} = 6.5$

$\Delta = N + 20\%$

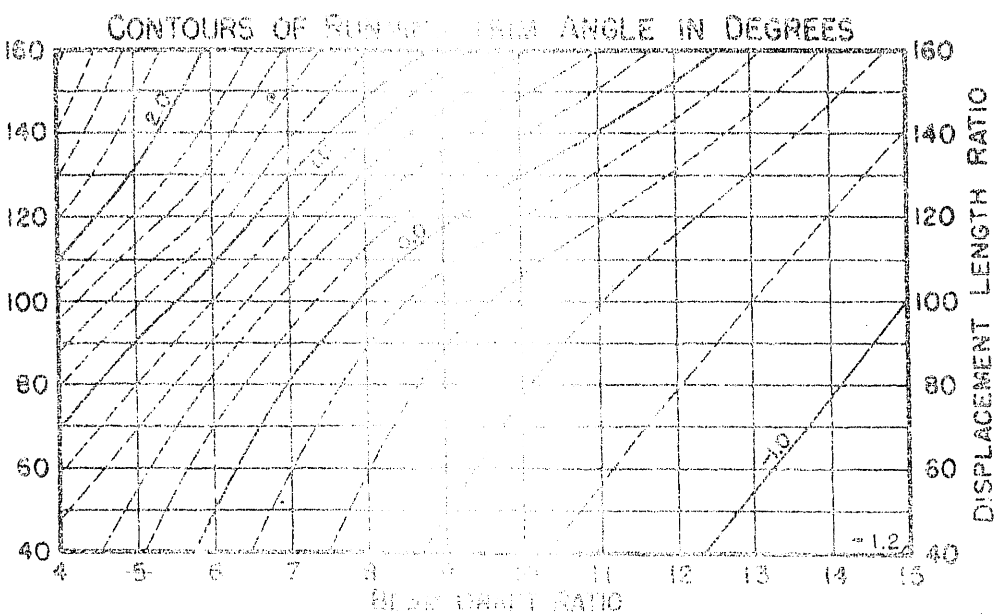
$\tau = 0°$



$\frac{V}{\sqrt{L}} = 6.5$

$\Delta = N + 20\%$

$\tau = 2°$



$\frac{V}{\sqrt{L}} = 6.5$

$\Delta = N + 20\%$

$\tau = 4°$

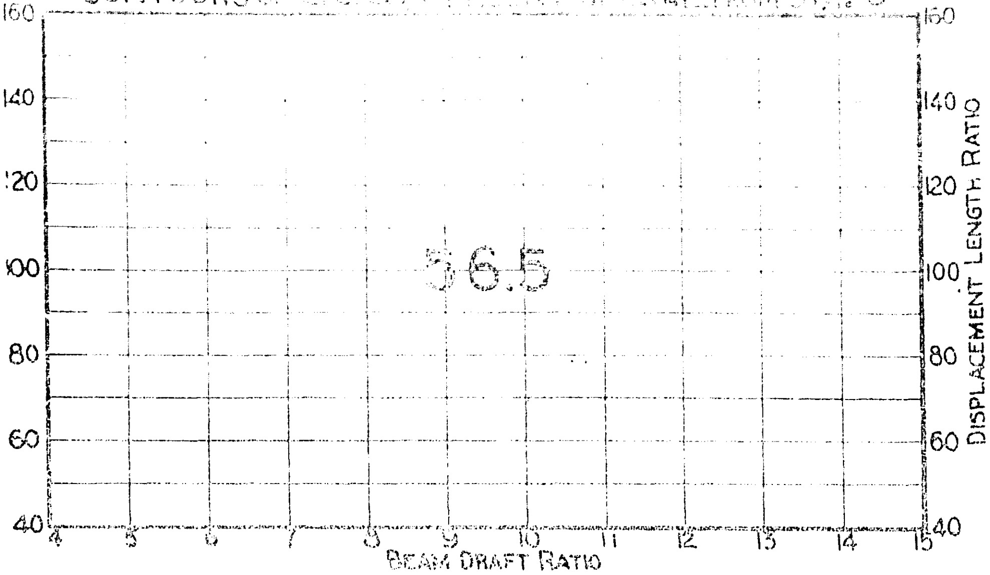
CONTOURS

OF

LONGITUDINAL CENTERS OF GRAVITY

[illegible] Conditions at which Tests were Made

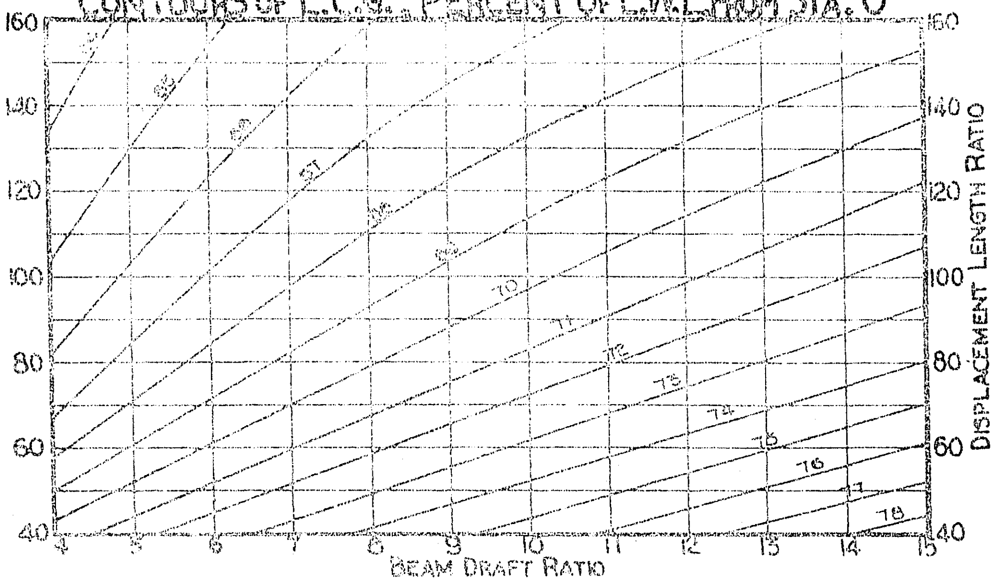
CONTOURS OF L.C.G., PERCENT OF L.W.L. FROM STA. "O"



$\Delta = N$

$\tau = 0°$

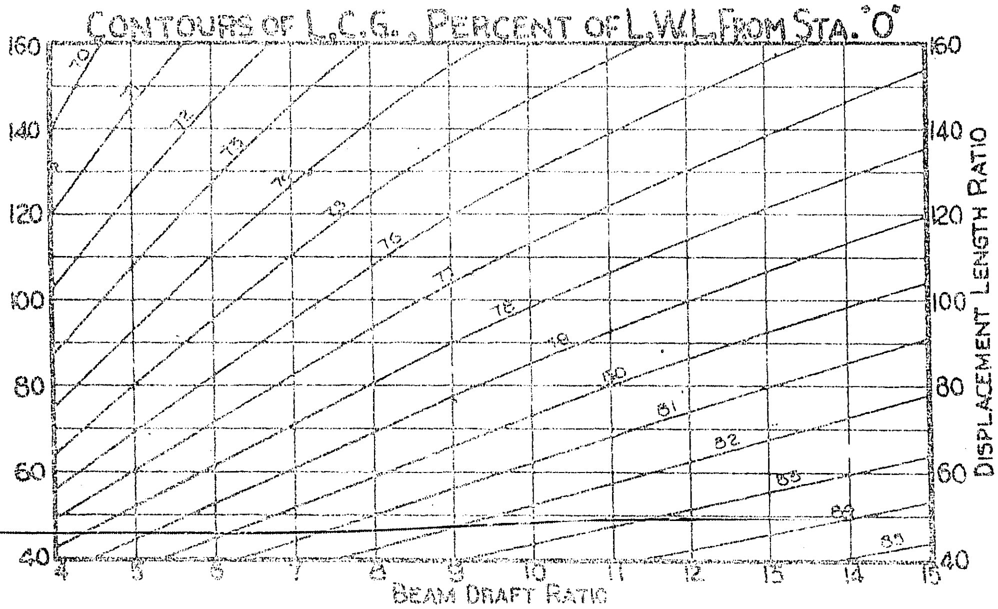
CONTOURS OF L.C.G., PERCENT OF L.W.L. FROM STA. "O"



$\Delta = N$

$\tau = 2°$

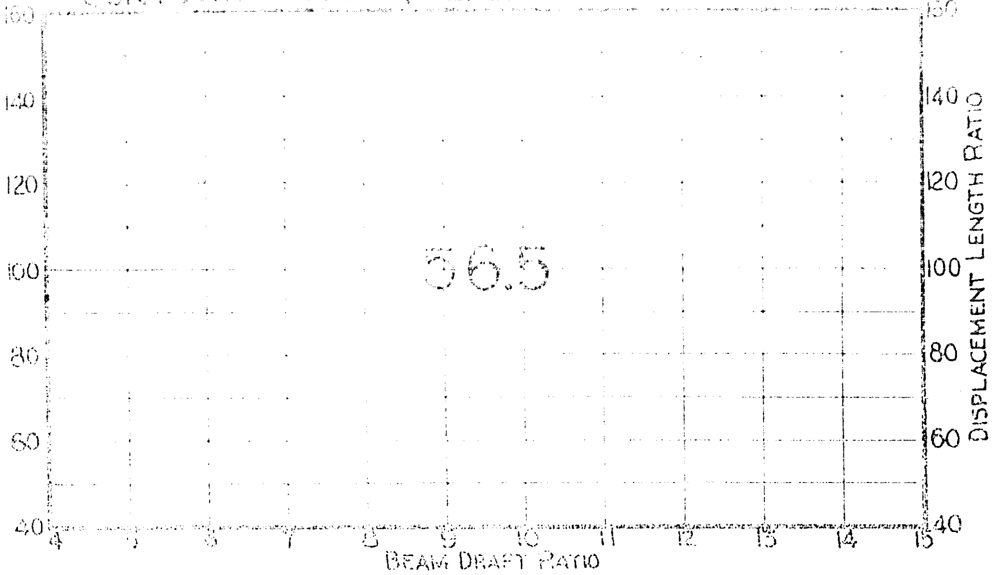
CONTOURS OF L.C.G., PERCENT OF L.W.L. FROM STA. "O"



$\Delta = N$

$\tau = 4°$

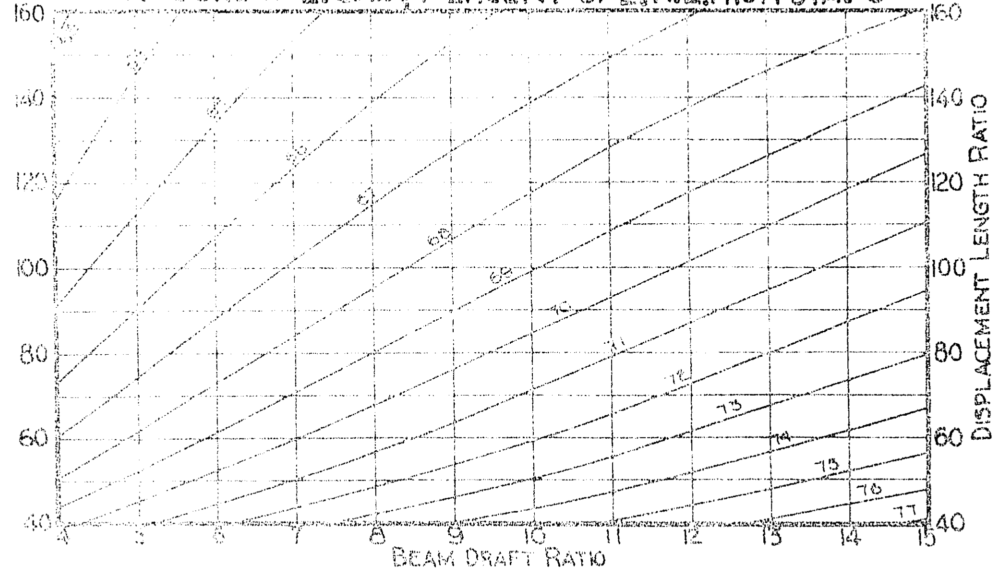
CONTOURS OF L.C.G., PERCENT OF L.W.L. FROM STA. "O"



$\Delta = N + 10\%$

$J = 0°$

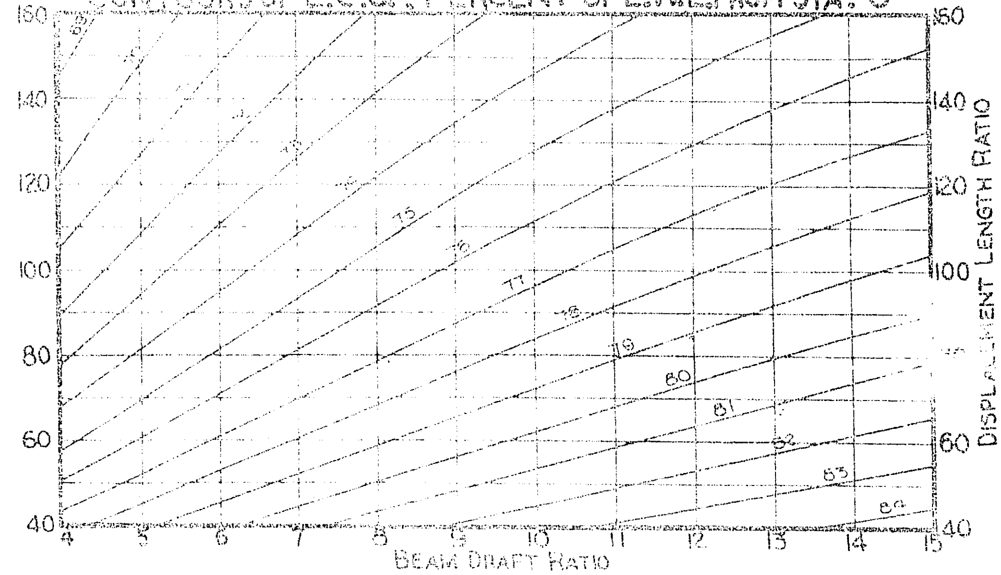
CONTOURS OF L.C.G., PERCENT OF L.W.L. FROM STA. "O"



$\Delta = N + 10\%$

$J = 2°$

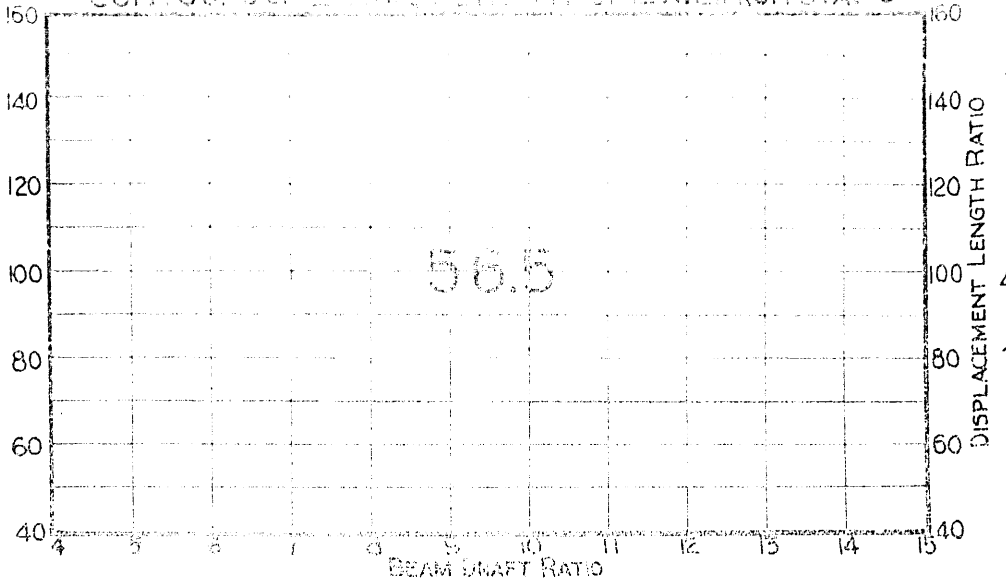
CONTOURS OF L.C.G., PERCENT OF L.W.L. FROM STA. "O"



$\Delta = N + 10\%$

$J = 4°$

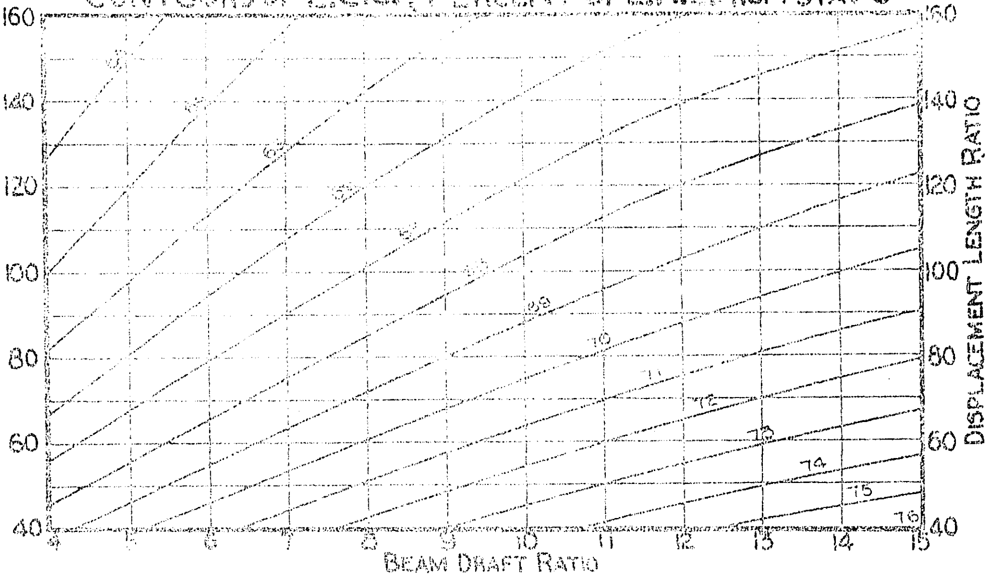
CONTOURS OF L.C.G., PERCENT OF L.W.L. FROM STA. "O"



Δ = N+20%

J = 0°

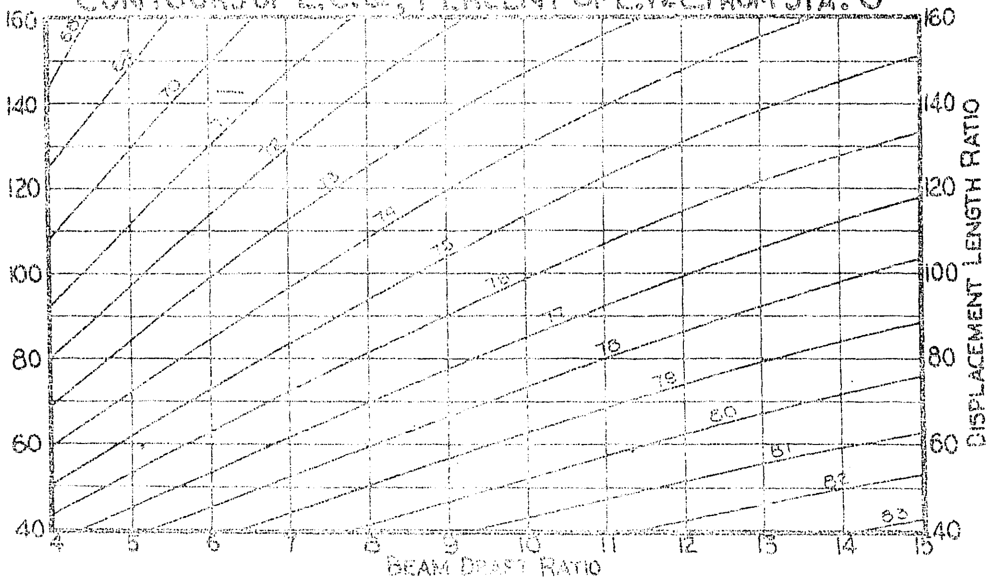
CONTOURS OF L.C.G., PERCENT OF L.W.L. FROM STA. "O"



Δ=N+20%

J = 2°

CONTOURS OF L.C.G., PERCENT OF L.W.L. FROM STA. "O"



Δ=N+20%

J = 4°

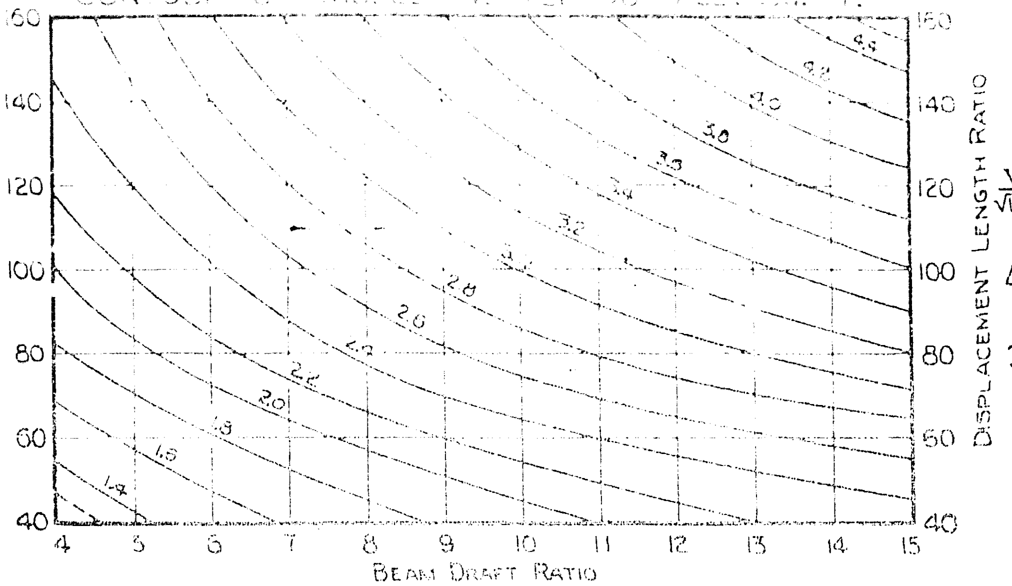
CONTOURS

OF

WETTED AREAS

Speed-Length Ratios 2.0-6.0 in Steps of 1.0

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

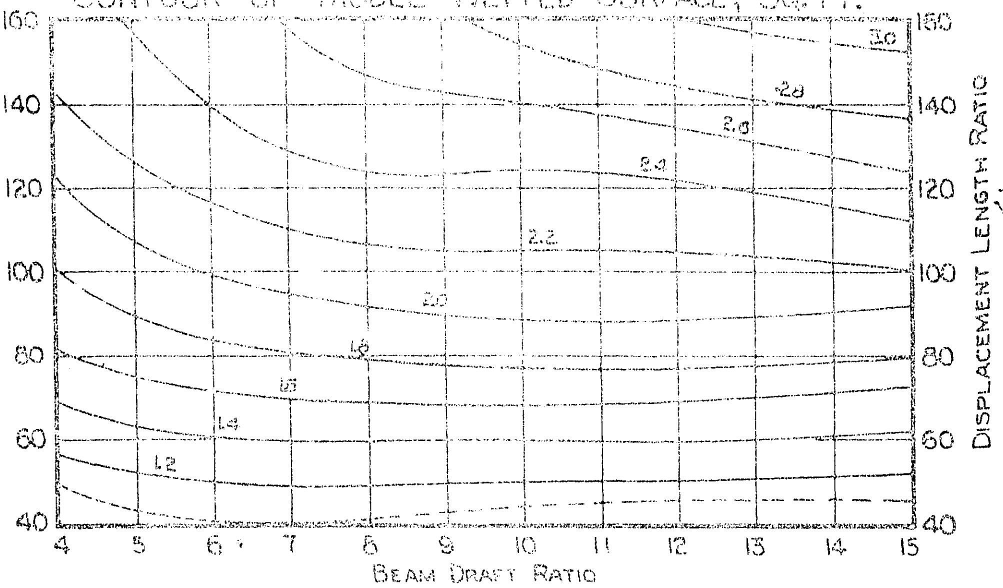


$\frac{V}{\sqrt{L}} = 2.0$

$\Delta =$ N

$J =$ 0°

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

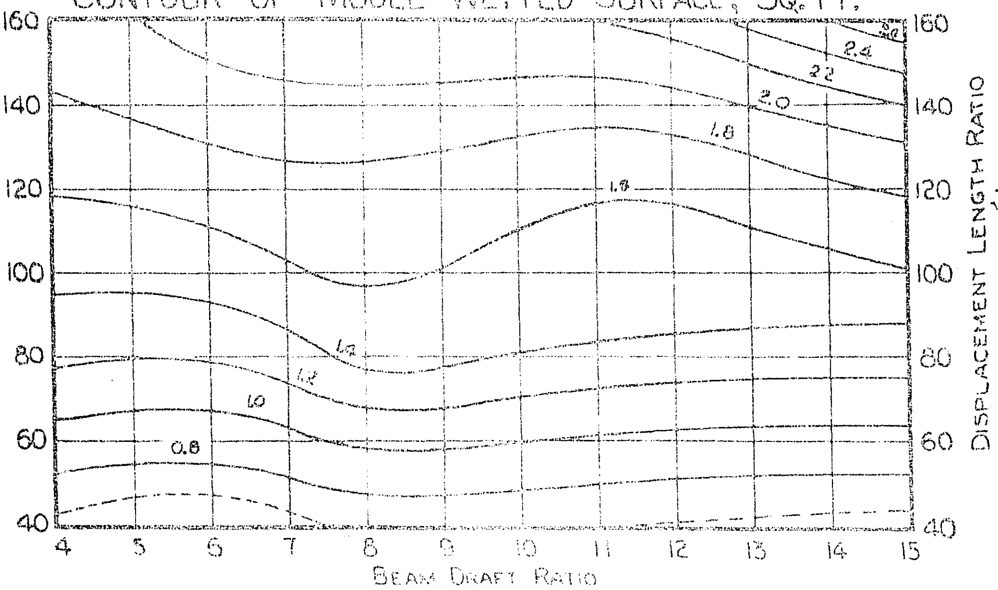


$\frac{V}{\sqrt{L}} = 2.0$

$\Delta =$ N

$J =$ 2°

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

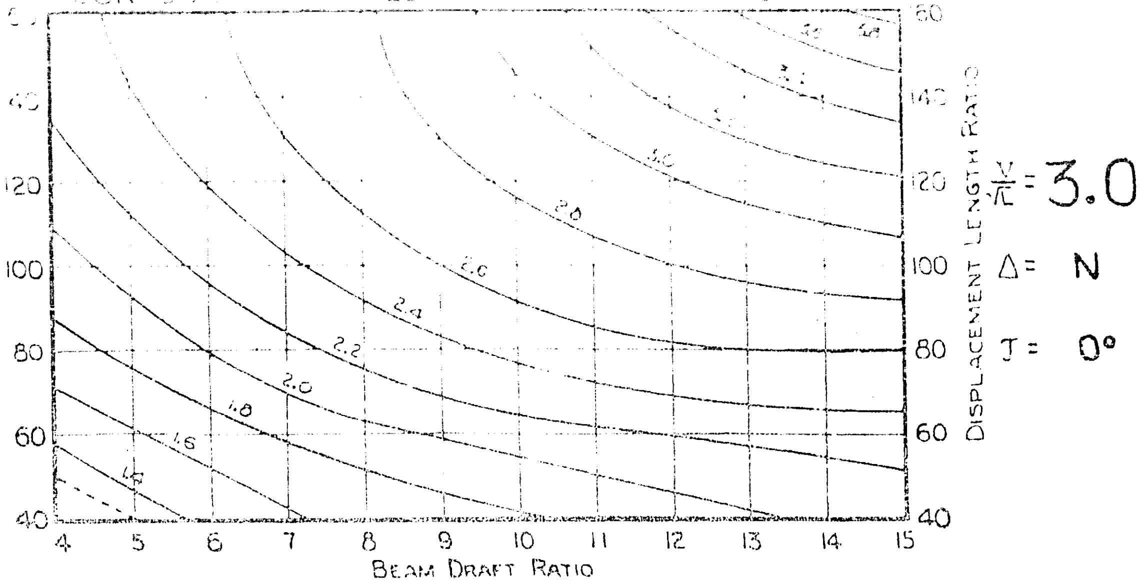


$\frac{V}{\sqrt{L}} = 2.0$

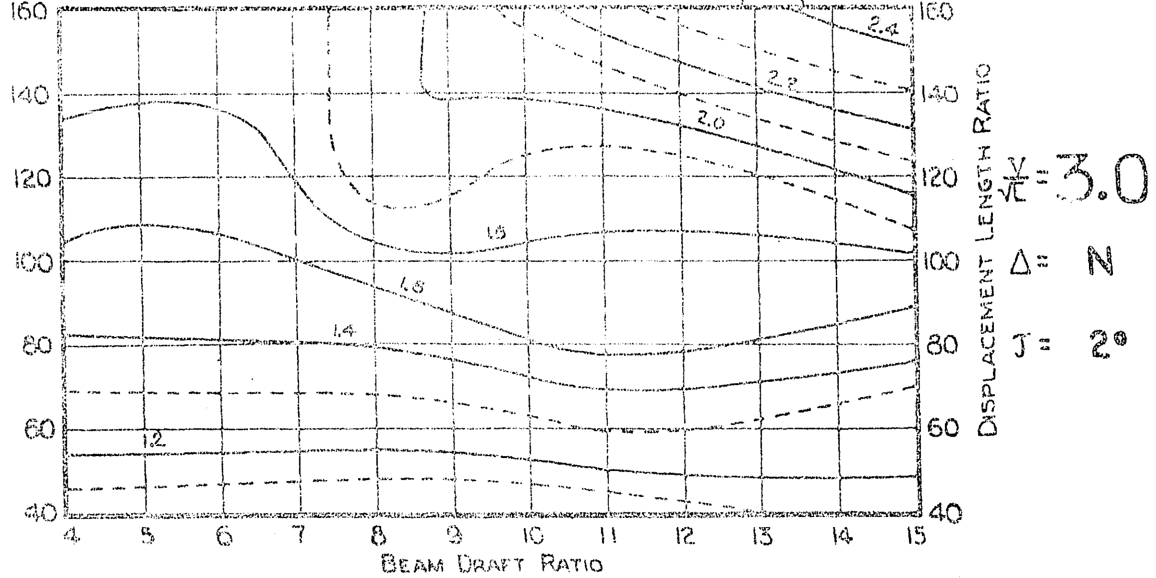
$\Delta =$ N

$J =$ 4°

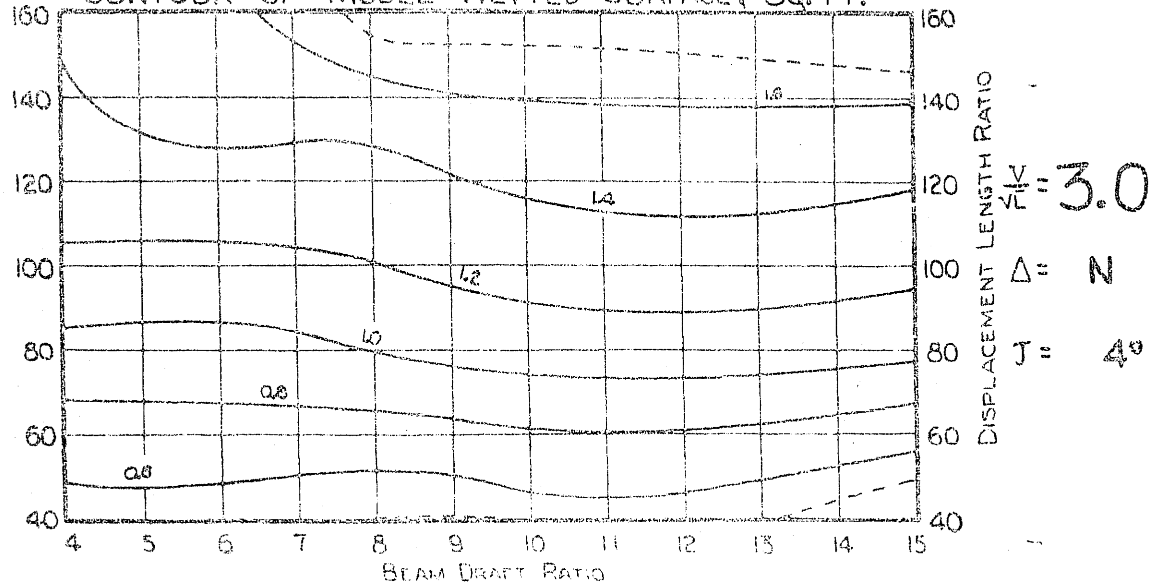
CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

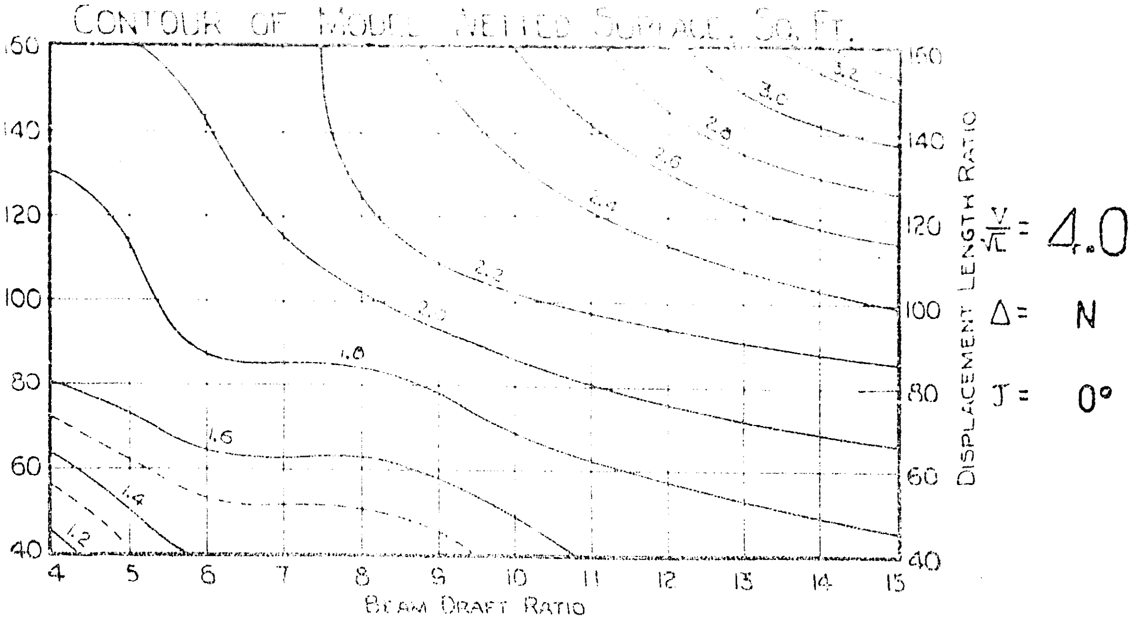


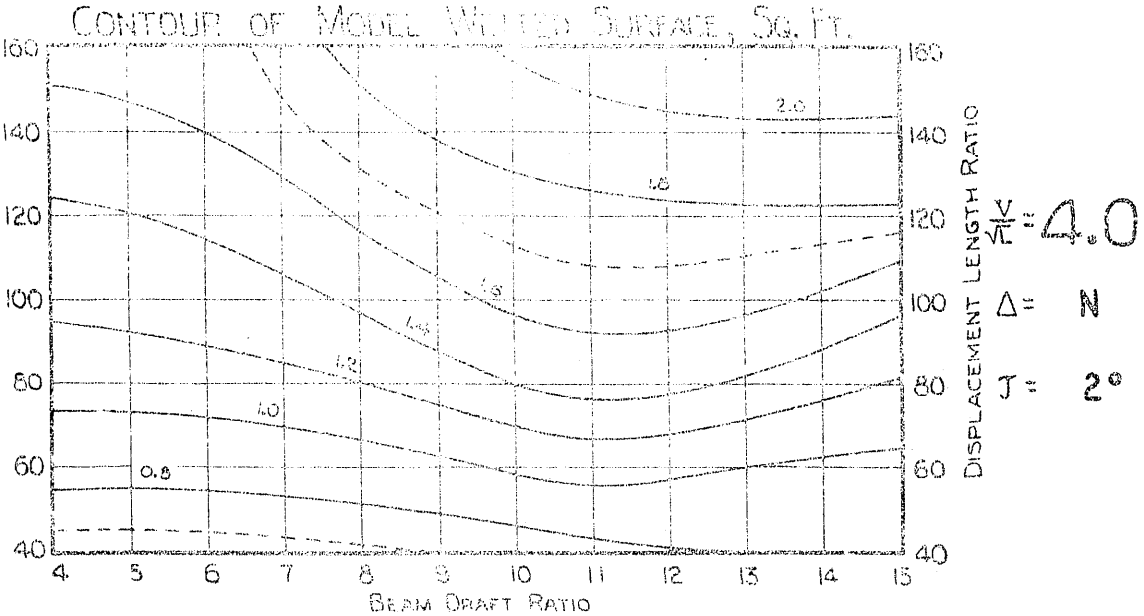
CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

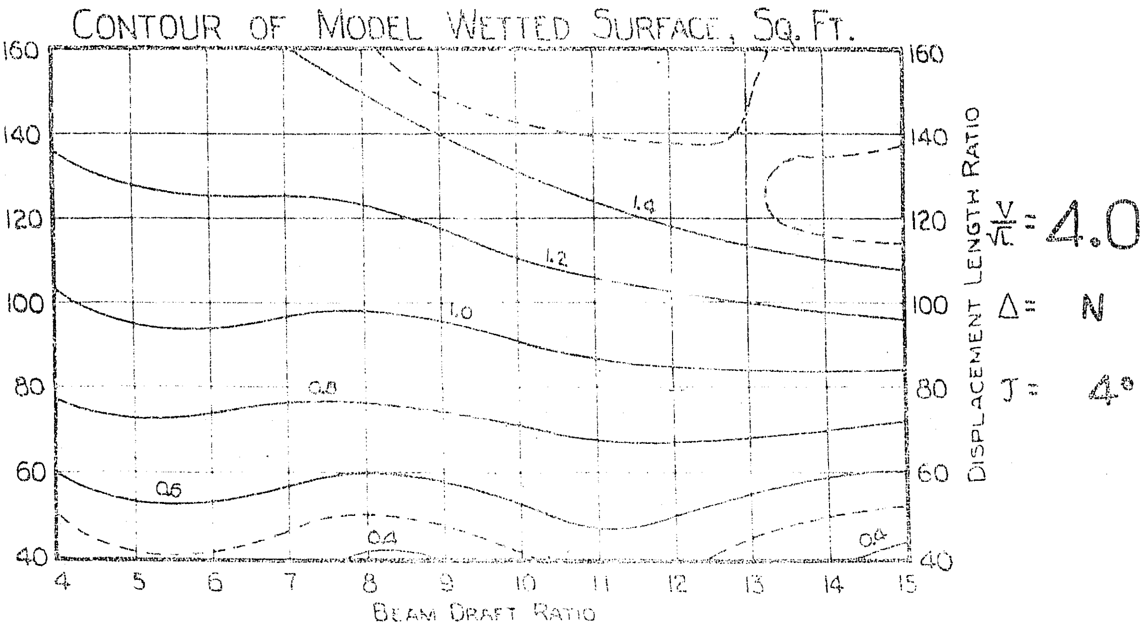


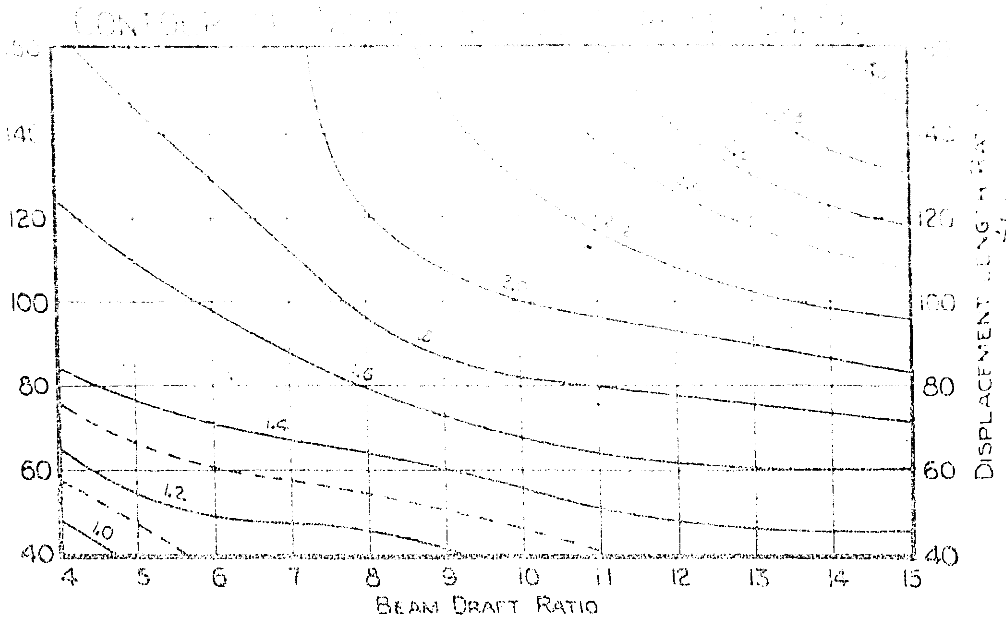
CONTOUR OF MODEL WETTED SURFACE, SQ. FT.




CONTOUR OF MODEL WETTED SURFACE, SQ. FT.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}}$ = 4.0
Δ = N
J = 0°


CONTOUR OF MODEL WETTED SURFACE, SQ. FT.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}}$ = 4.0
Δ = N
J = 2°


CONTOUR OF MODEL WETTED SURFACE, SQ. FT.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}}$ = 4.0
Δ = N
J = 4°

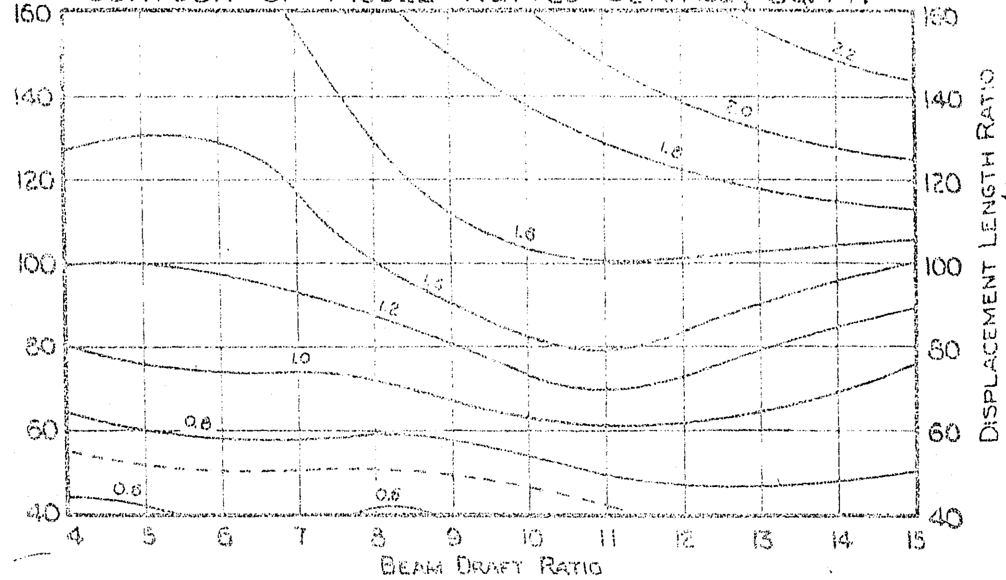


$\frac{V}{\sqrt{L}} = 5.0$

$\Delta =$ N

$\mathcal{T} =$ 0°

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

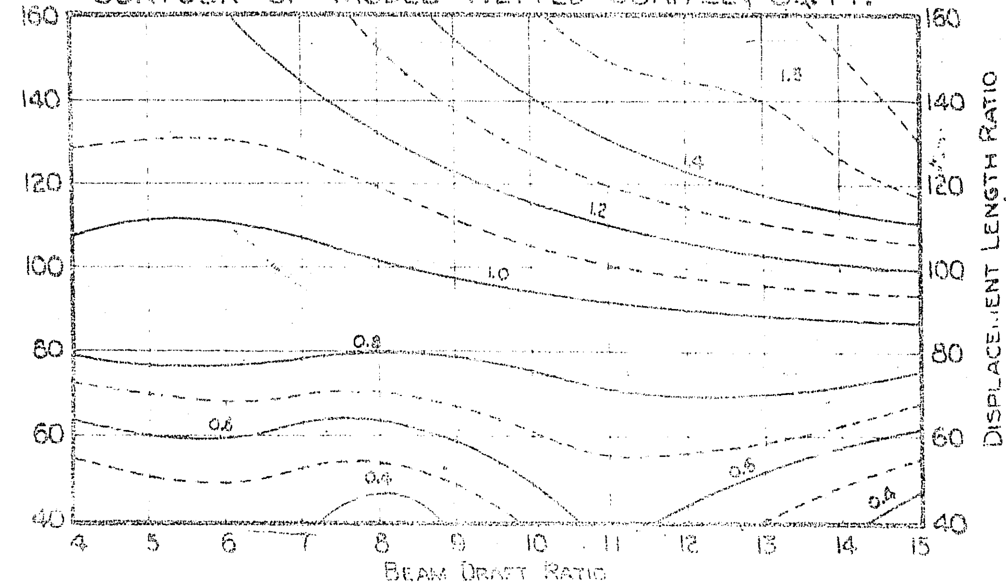


$\frac{V}{\sqrt{L}} = 5.0$

$\Delta =$ N

$\mathcal{T} =$ 2°

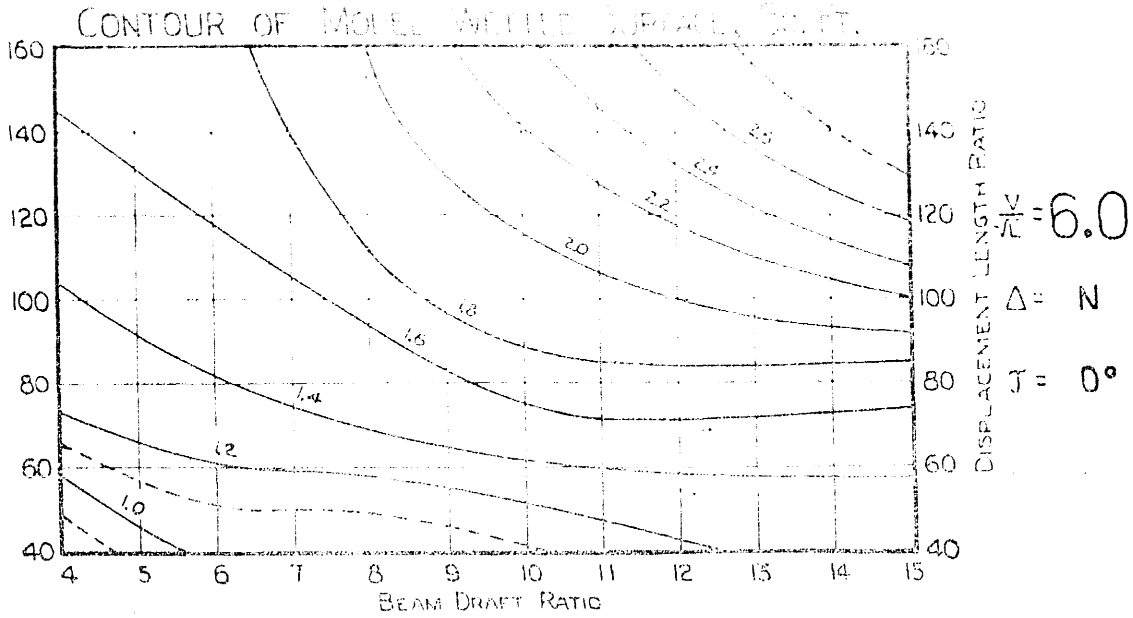
CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

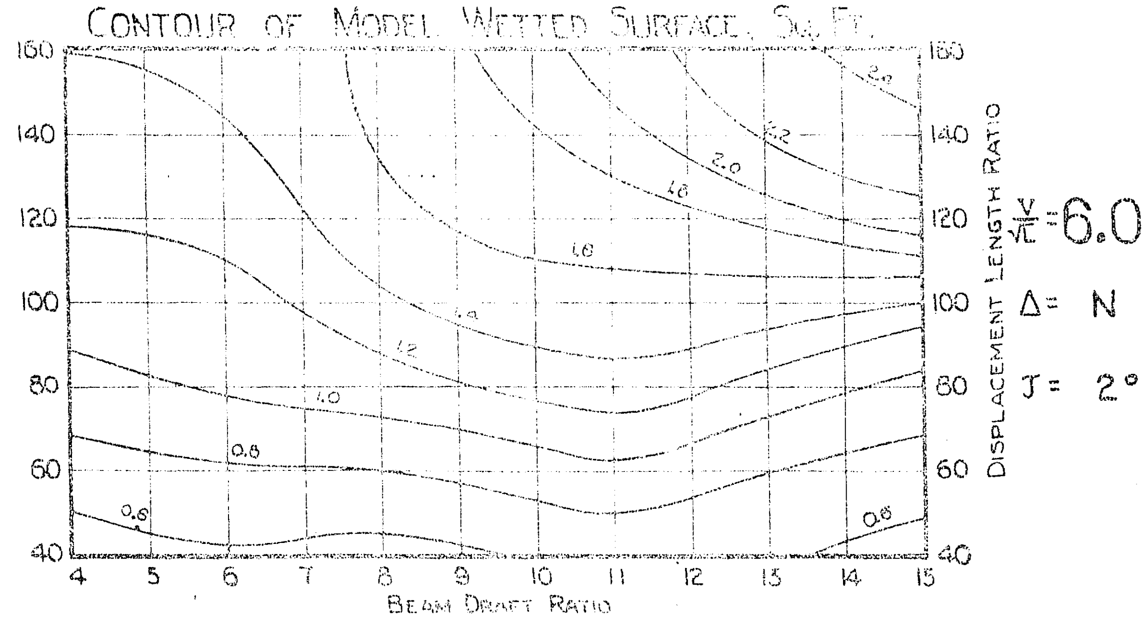


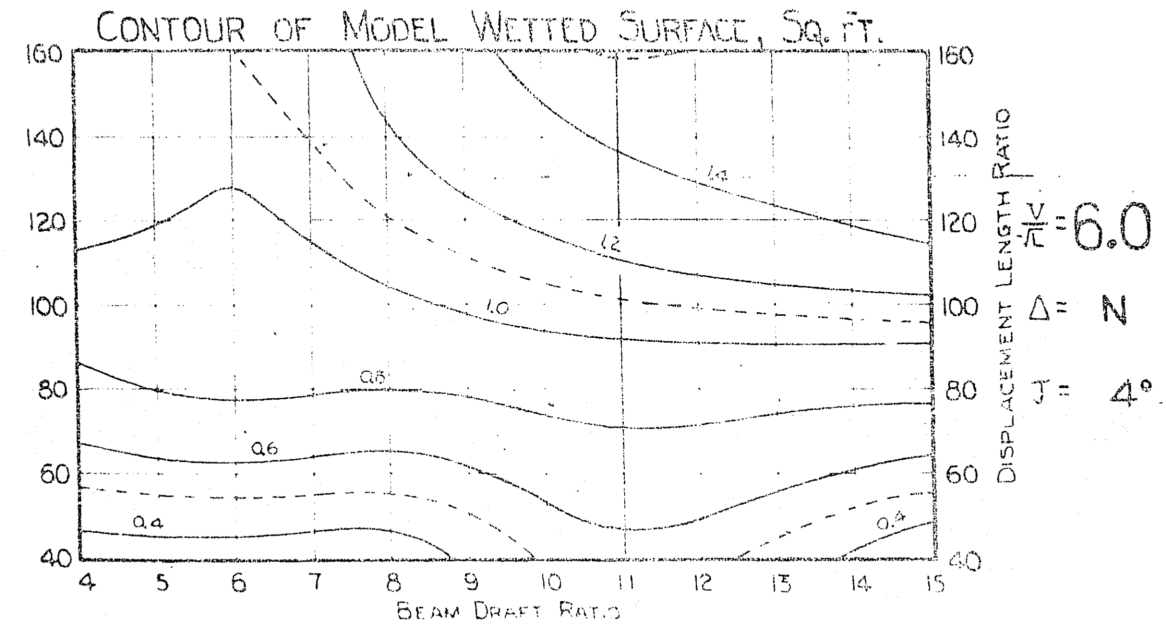
$\frac{V}{\sqrt{L}} = 5.0$

$\Delta =$ N

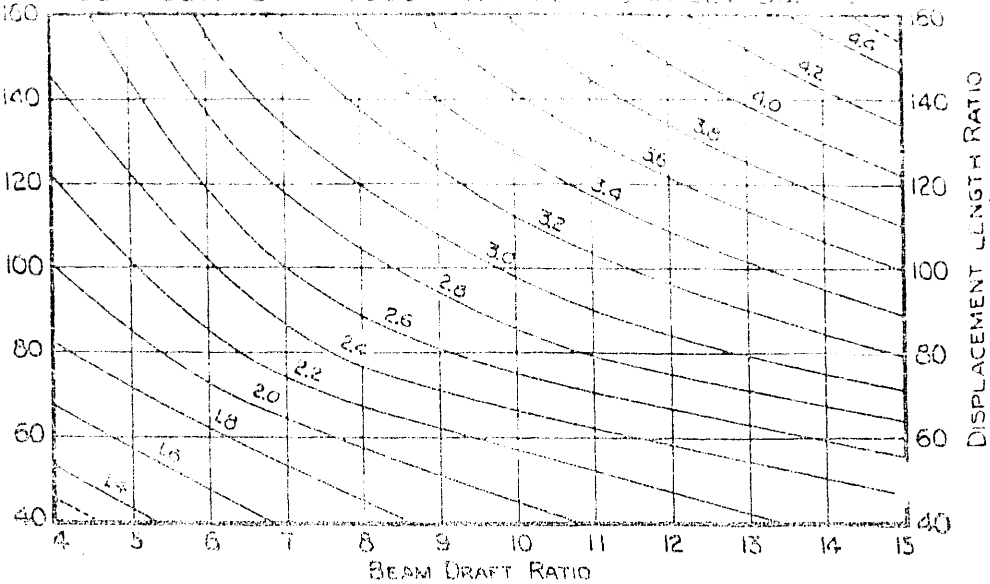
$\mathcal{T} =$ 4°


CONTOUR OF MODEL WETTED SURFACE, SQ. FT.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 6.0$
Δ = N
J = 0°


CONTOUR OF MODEL WETTED SURFACE, SQ. FT.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 6.0$
Δ = N
J = 2°


CONTOUR OF MODEL WETTED SURFACE, SQ. FT.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}} = 6.0$
Δ = N
J = 4°

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

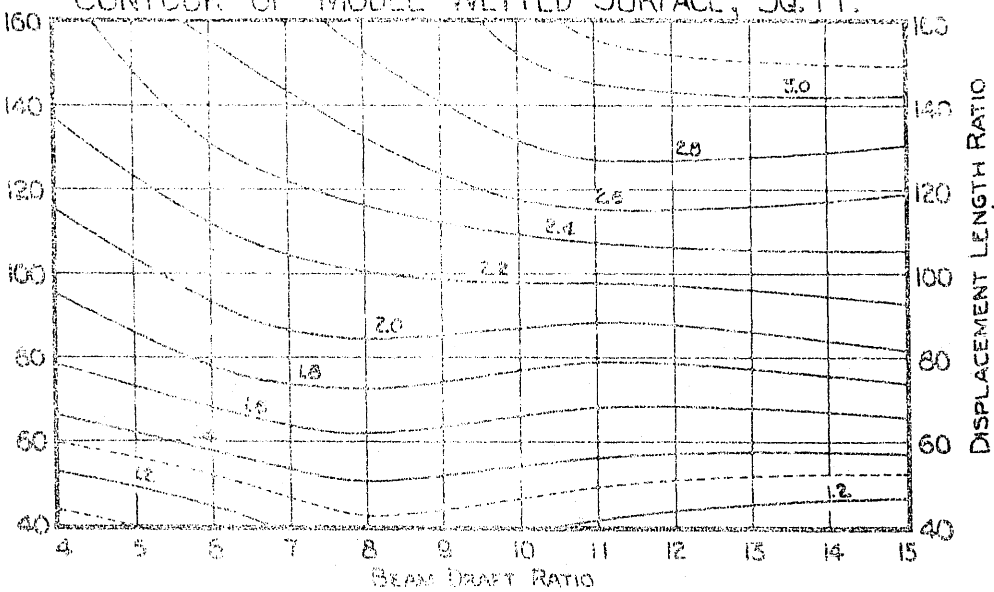


$\frac{V}{\sqrt{L}} = 2.0$

$\Delta = N + 20\%$

J = 0°

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

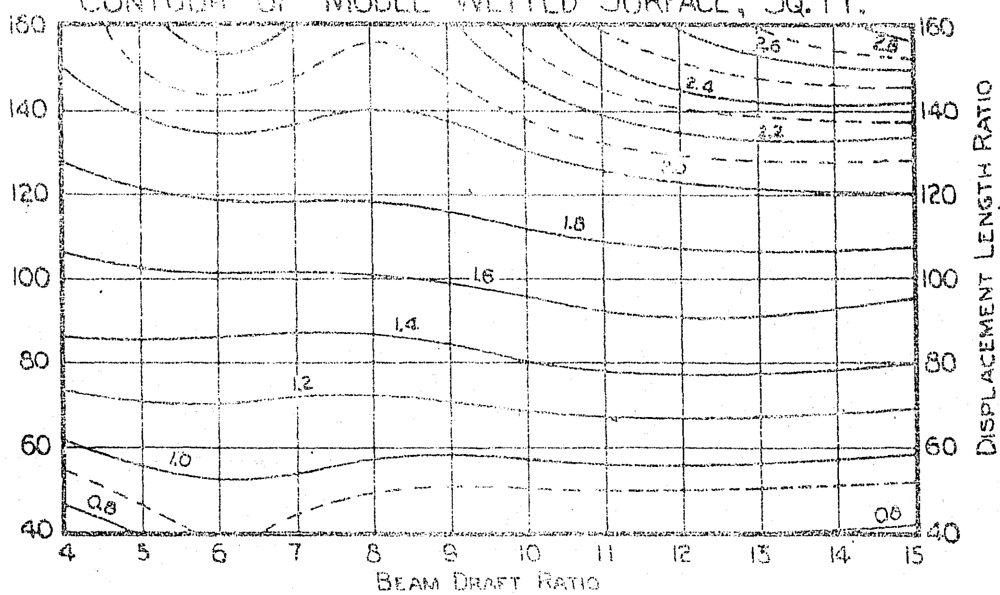


$\frac{V}{\sqrt{L}} = 2.0$

$\Delta = N + 20\%$

J = 2°

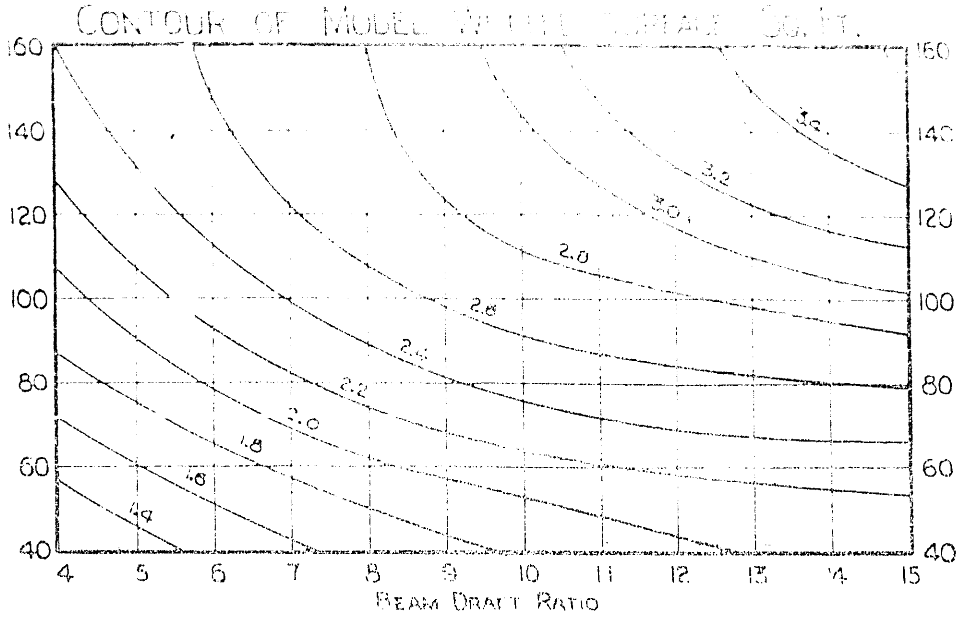
CONTOUR OF MODEL WETTED SURFACE, SQ. FT.



$\frac{V}{\sqrt{L}} = 2.0$

$\Delta = N + 20\%$

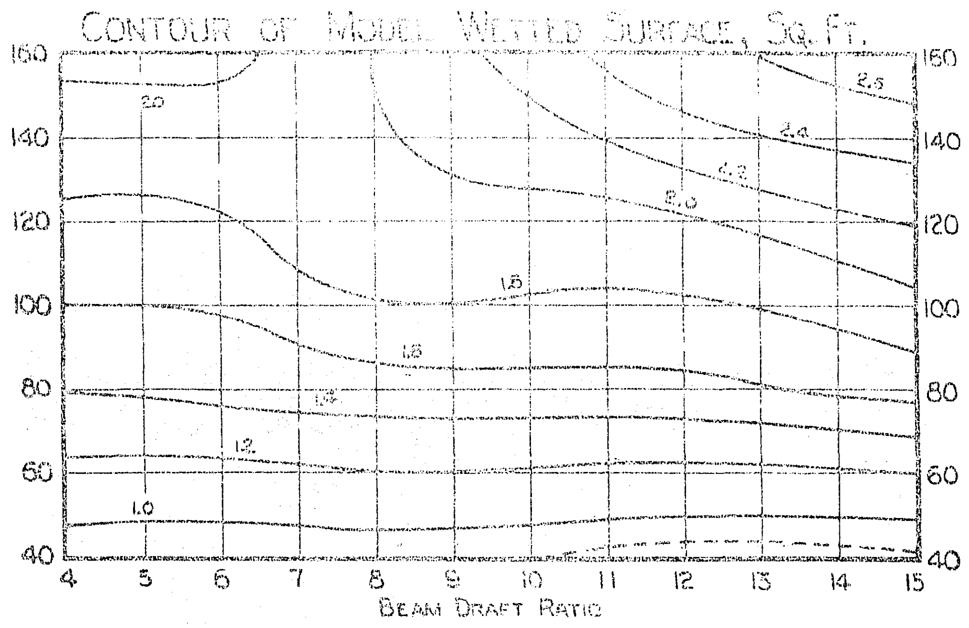
J = 4°



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 20\%$

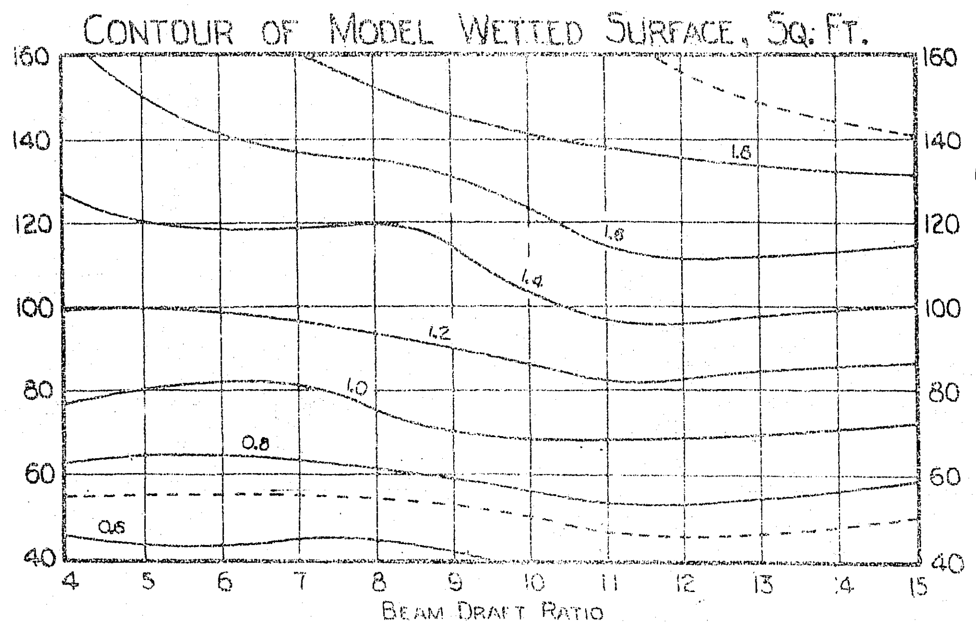
J = 0°



$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 20\%$

J = 2°

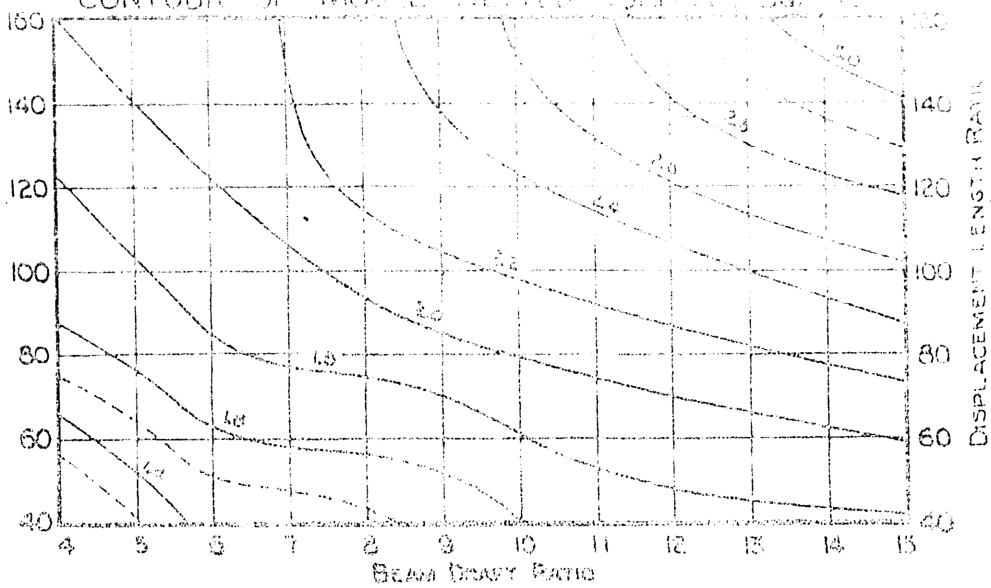


$\frac{V}{\sqrt{L}} = 3.0$

$\Delta = N + 20\%$

J = 4°

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

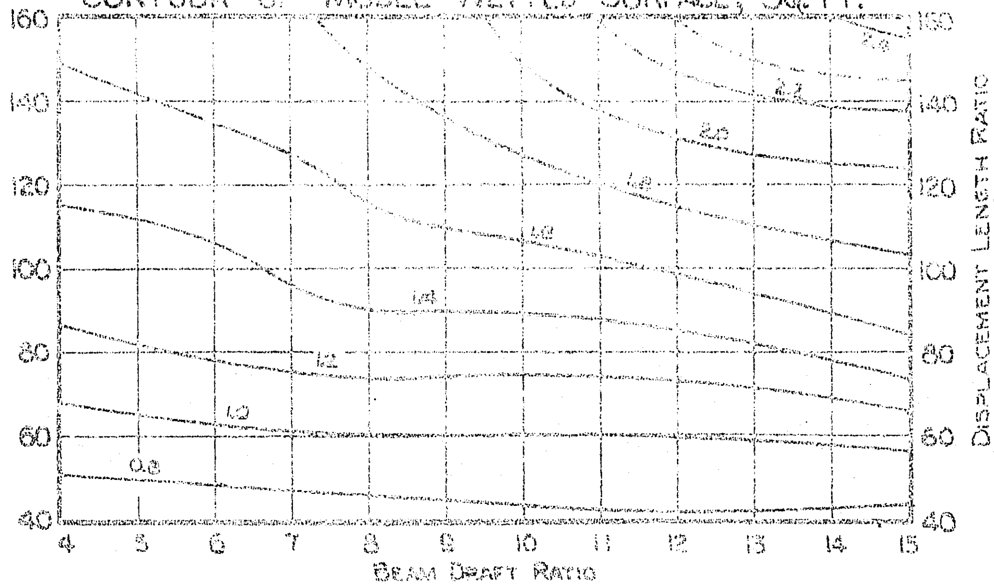


$\frac{V}{\sqrt{L}} = 4.0$

$\Delta = N + 20\%$

$J = 0°$

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

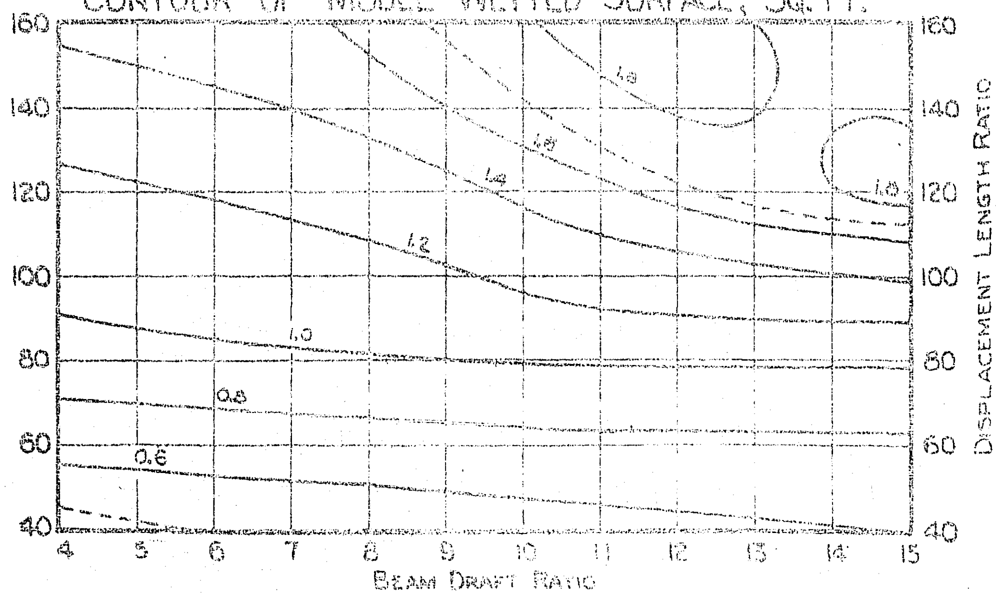


$\frac{V}{\sqrt{L}} = 4.0$

$\Delta = N + 20\%$

$J = 2°$

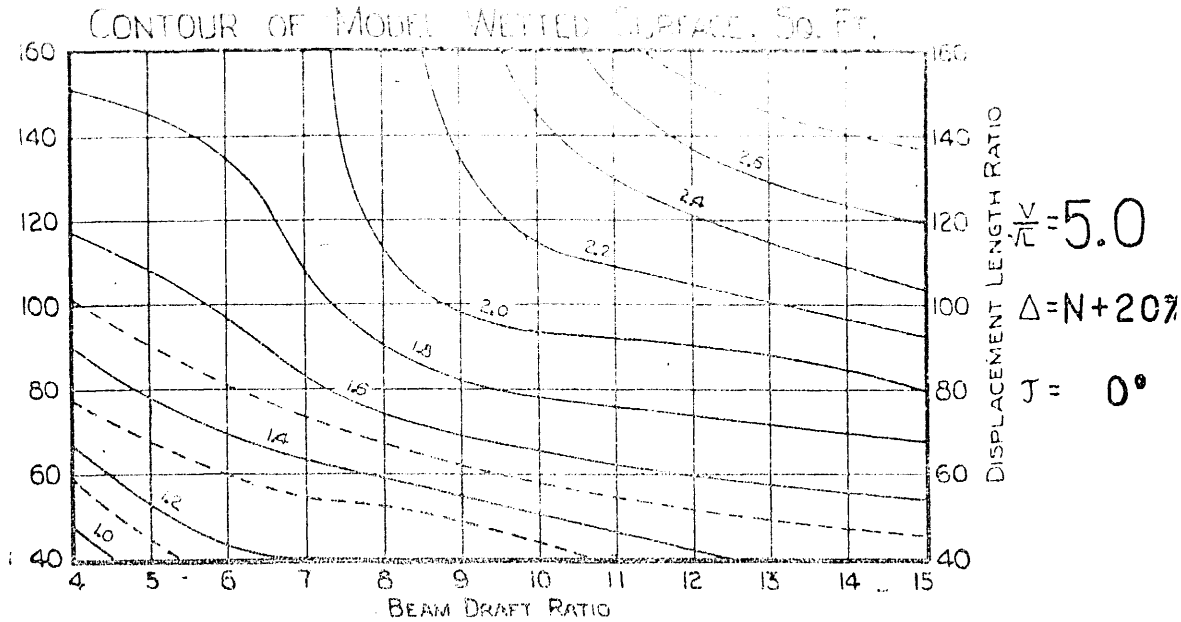
CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

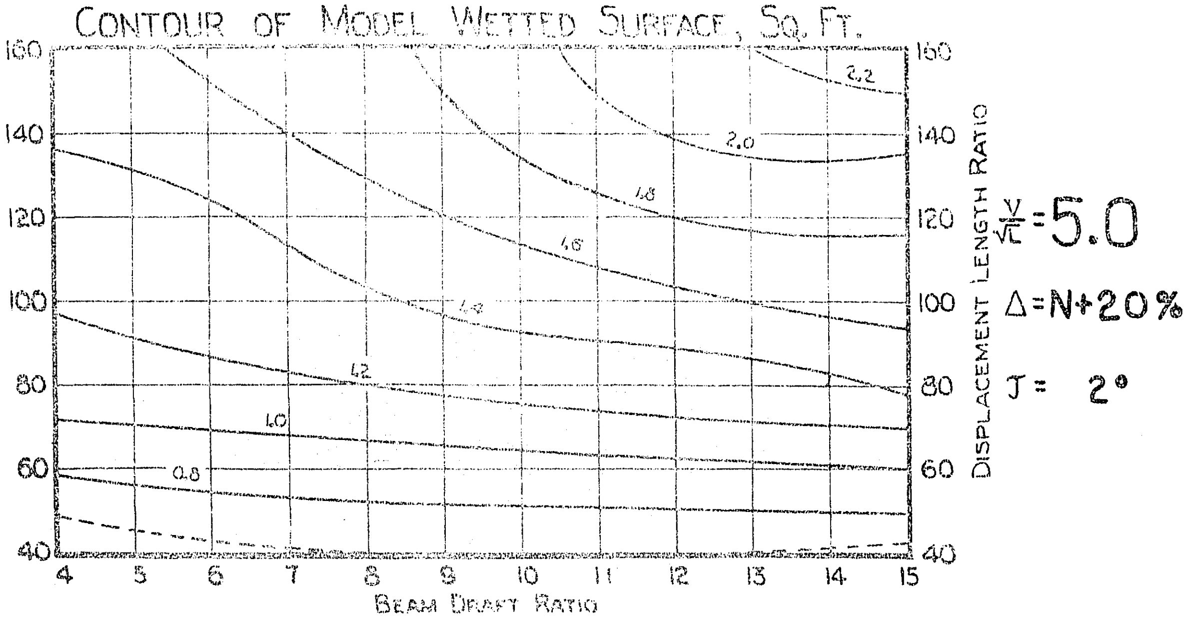


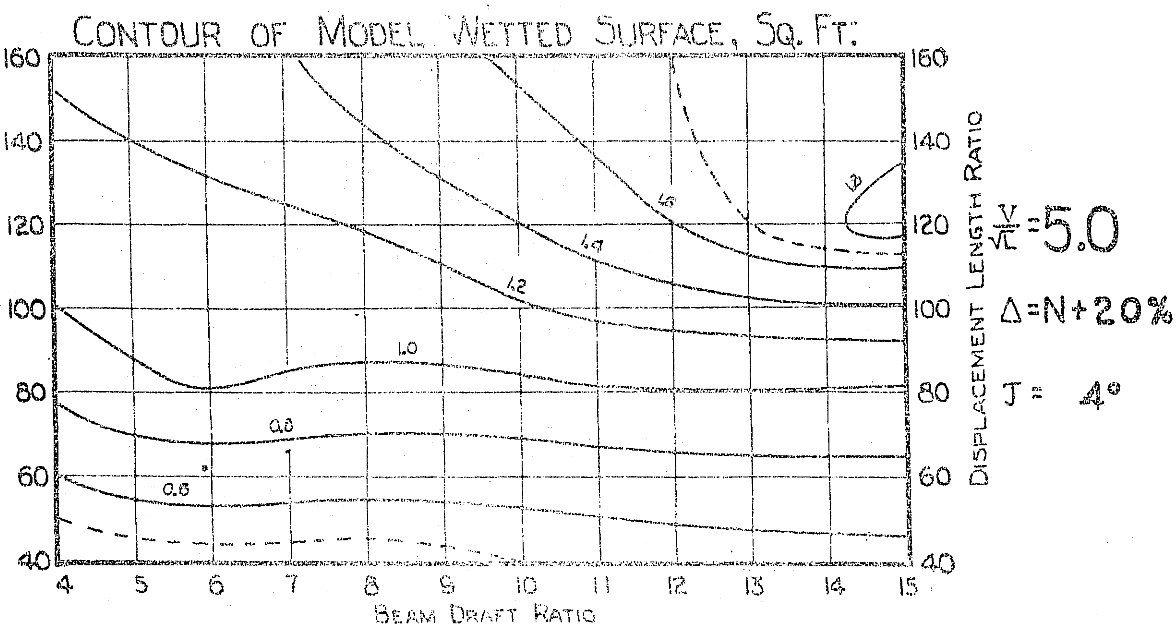
$\frac{V}{\sqrt{L}} = 4.0$

$\Delta = N + 20\%$

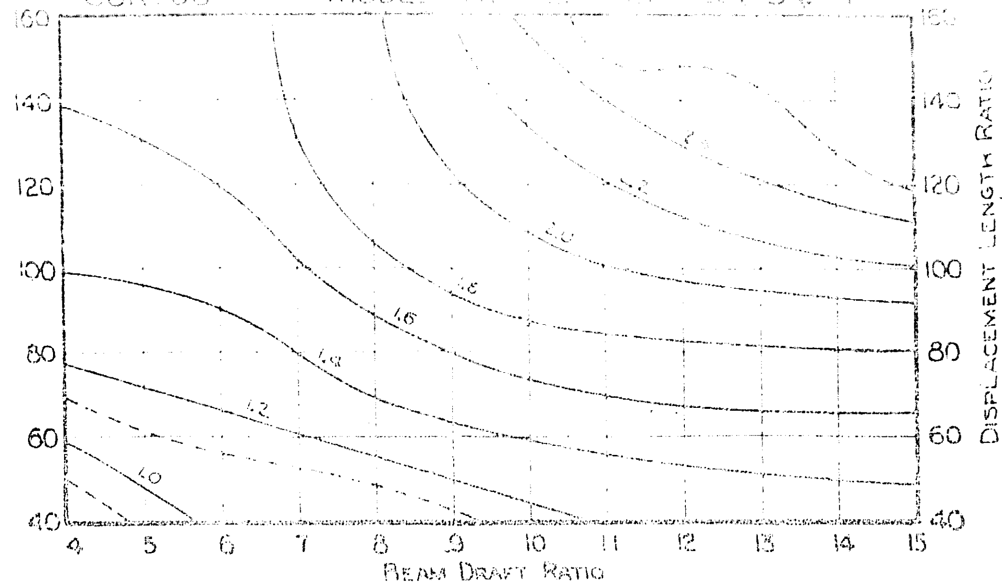
$J = 4°$


CONTOUR OF MODEL WETTED SURFACE, SQ. FT.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}}=5.0$
$\Delta = N + 20\%$
J = 0°


CONTOUR OF MODEL WETTED SURFACE, SQ. FT.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}}=5.0$
$\Delta = N + 20\%$
J = 2°


CONTOUR OF MODEL WETTED SURFACE, SQ. FT.
DISPLACEMENT LENGTH RATIO
BEAM DRAFT RATIO
$\frac{V}{\sqrt{L}}=5.0$
$\Delta = N + 20\%$
J = 4°

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

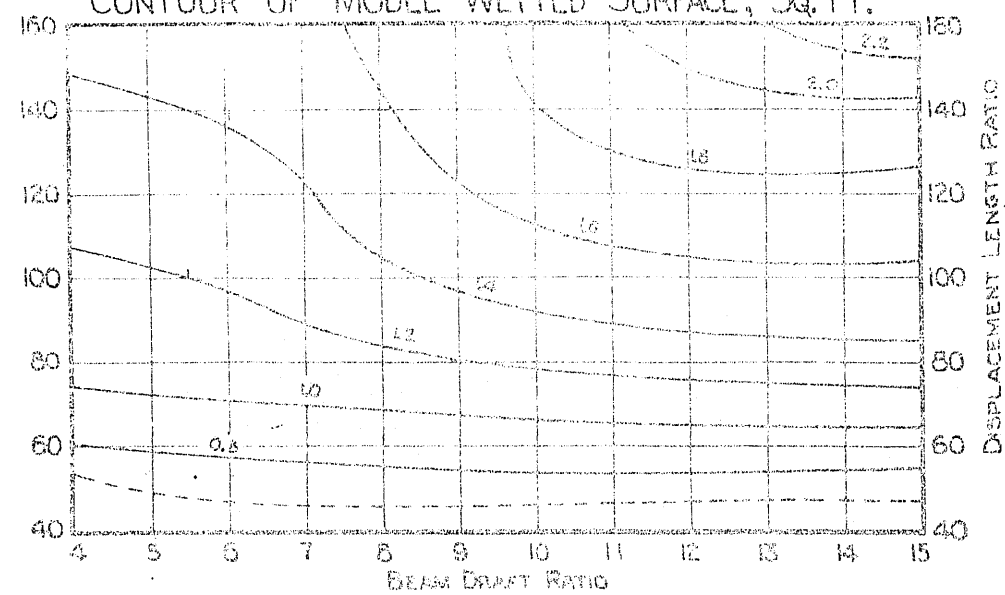


$\frac{V}{\sqrt{L}} = 6.0$

$\Delta = N + 20\%$

$J = 0°$

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.

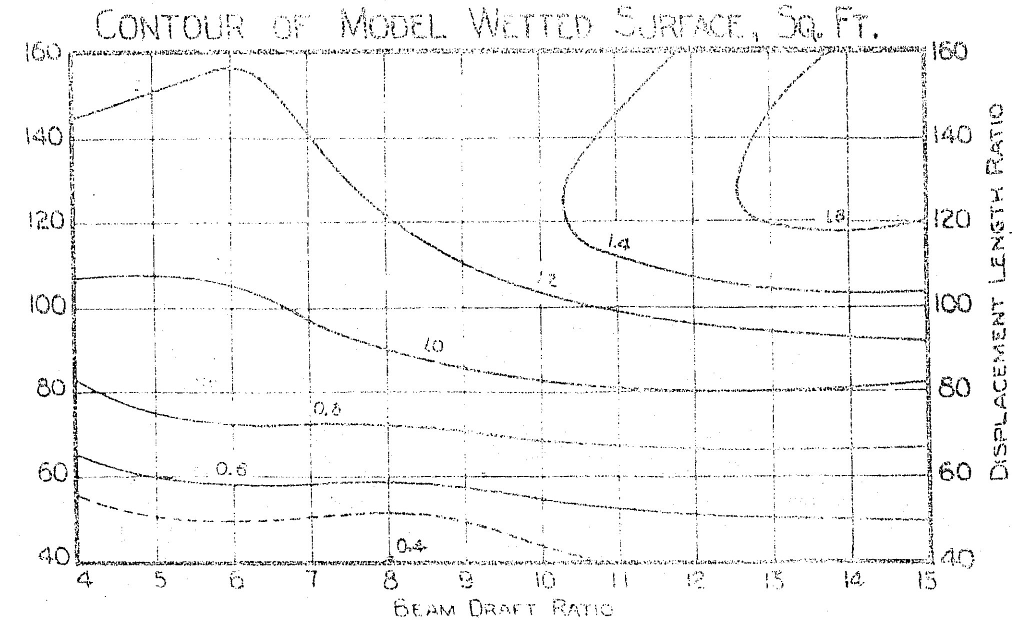


$\frac{V}{\sqrt{L}} = 6.0$

$\Delta = N + 20\%$

$J = 2°$

CONTOUR OF MODEL WETTED SURFACE, SQ. FT.



$\frac{V}{\sqrt{L}} = 6.0$

$\Delta = N + 20\%$

$J = 4°$

CHARTS

OF

LIMITING SPEED-LENGTH RATIO

FOR

LONGITUDINAL STABILITY

AND

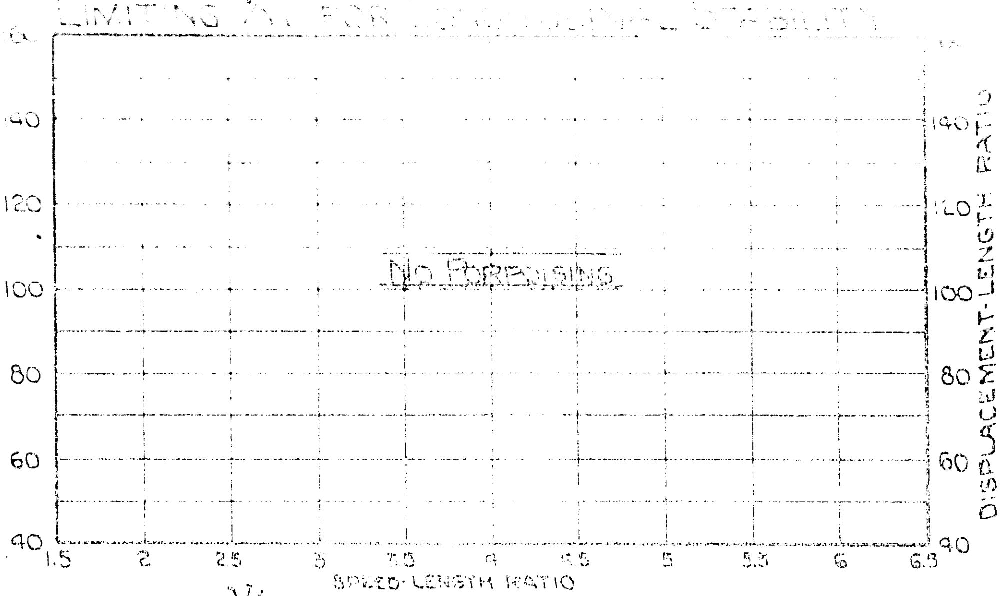
CHARTS OF GRAPHICAL RECORDS

OF

PORPOISING CYCLES

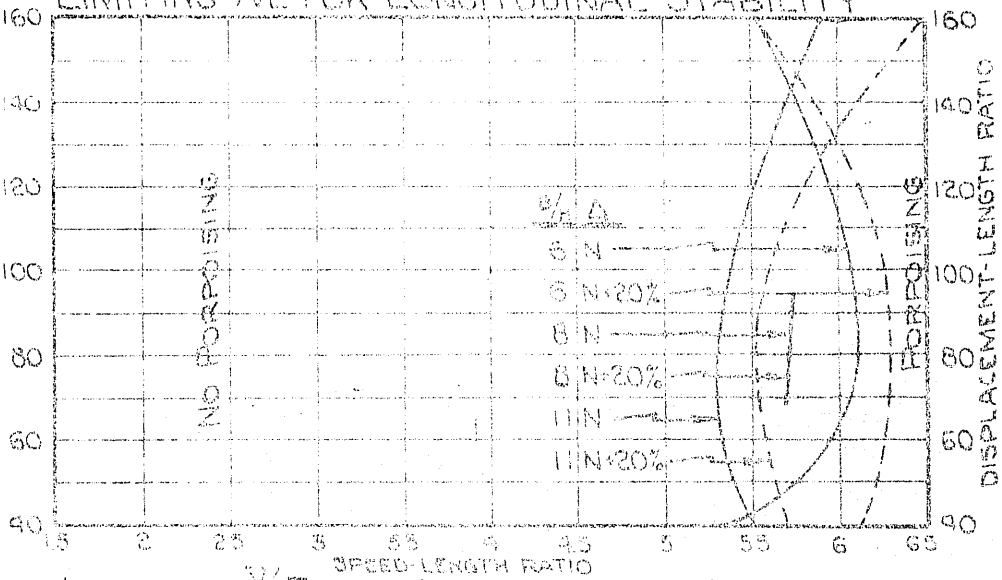
Pages
96 to 103

LIMITING V/√L FOR LONGITUDINAL STABILITY



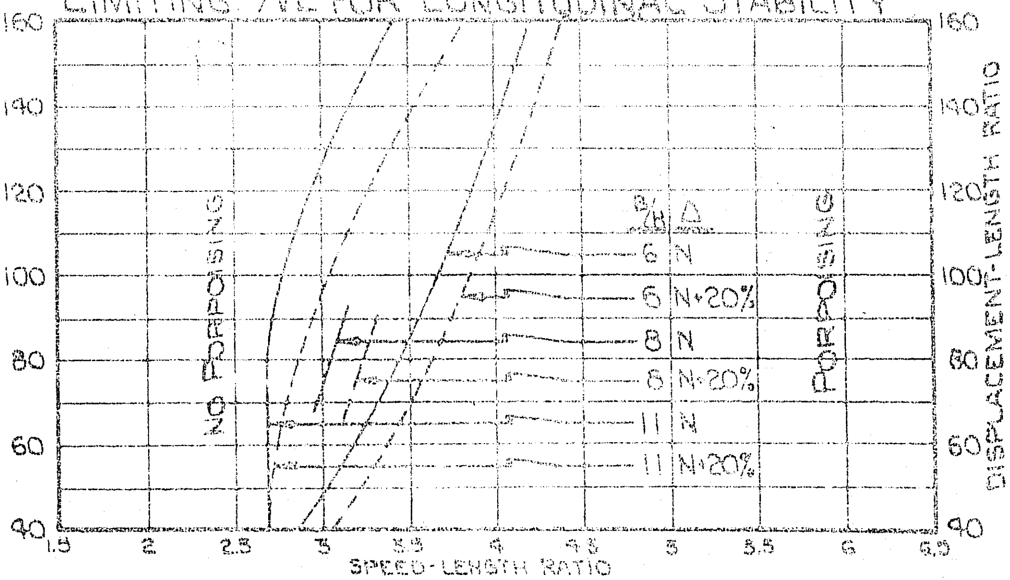
τ=0°

LIMITING V/√L FOR LONGITUDINAL STABILITY



τ=2°

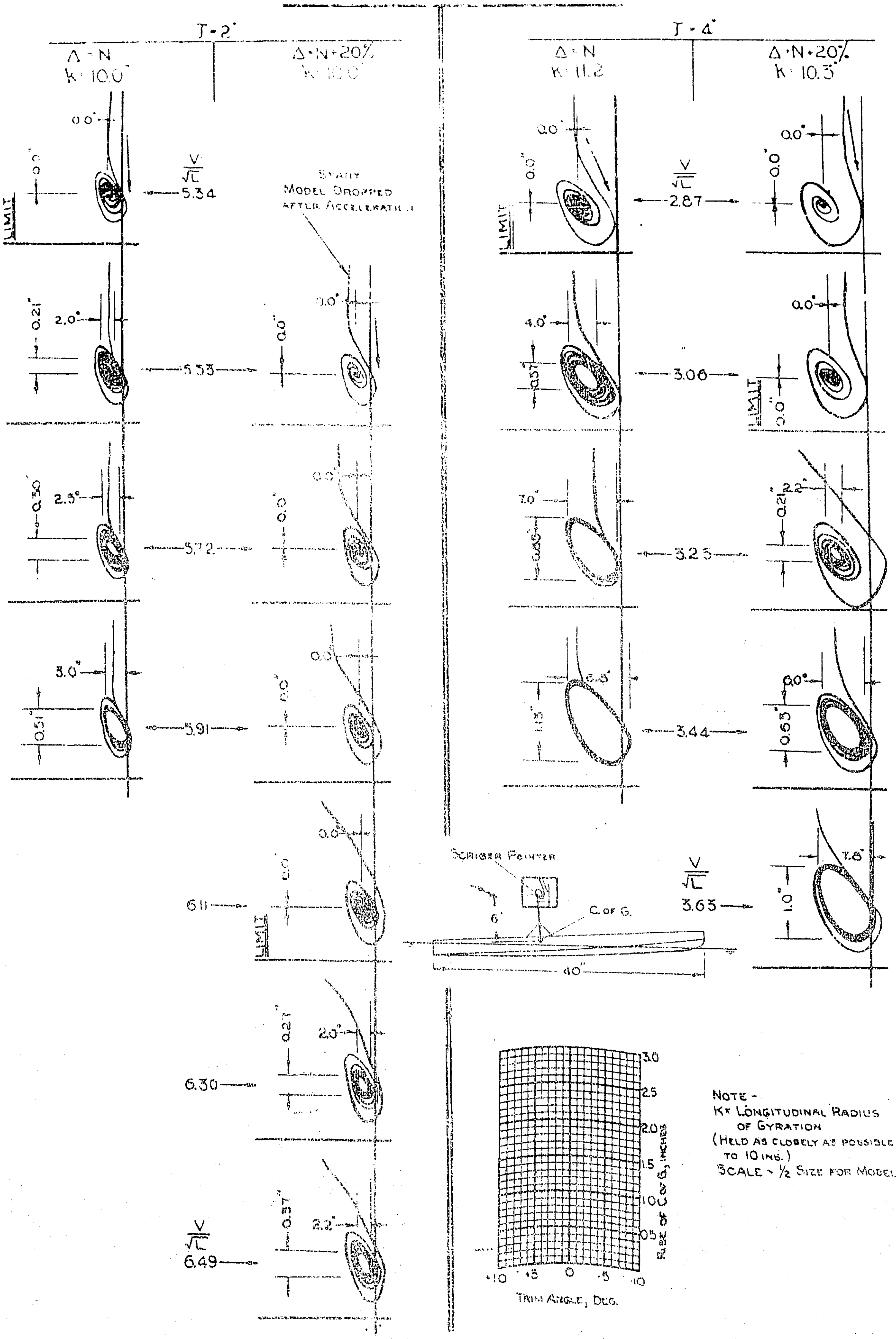
LIMITING V/√L FOR LONGITUDINAL STABILITY

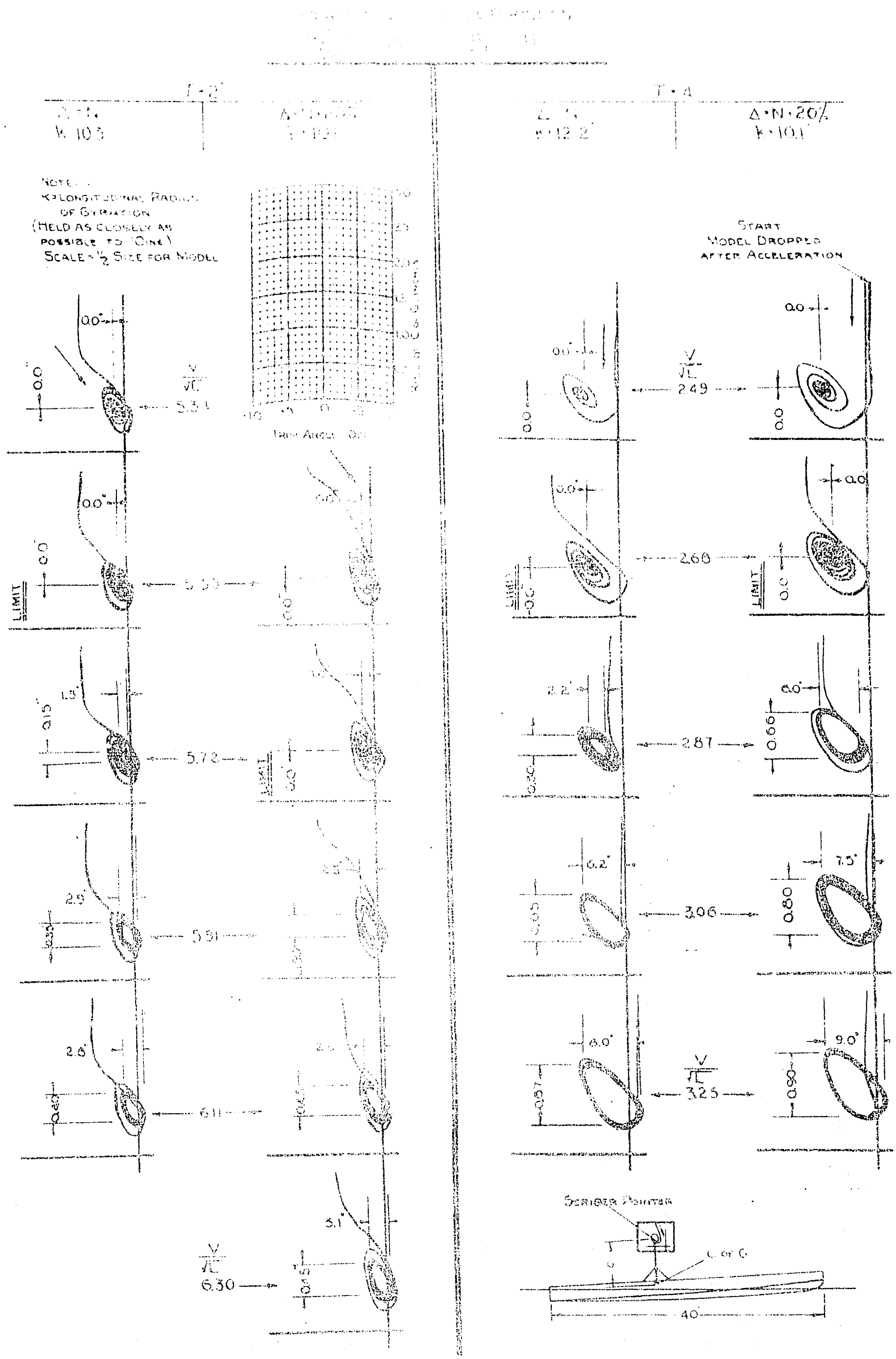


τ=4°

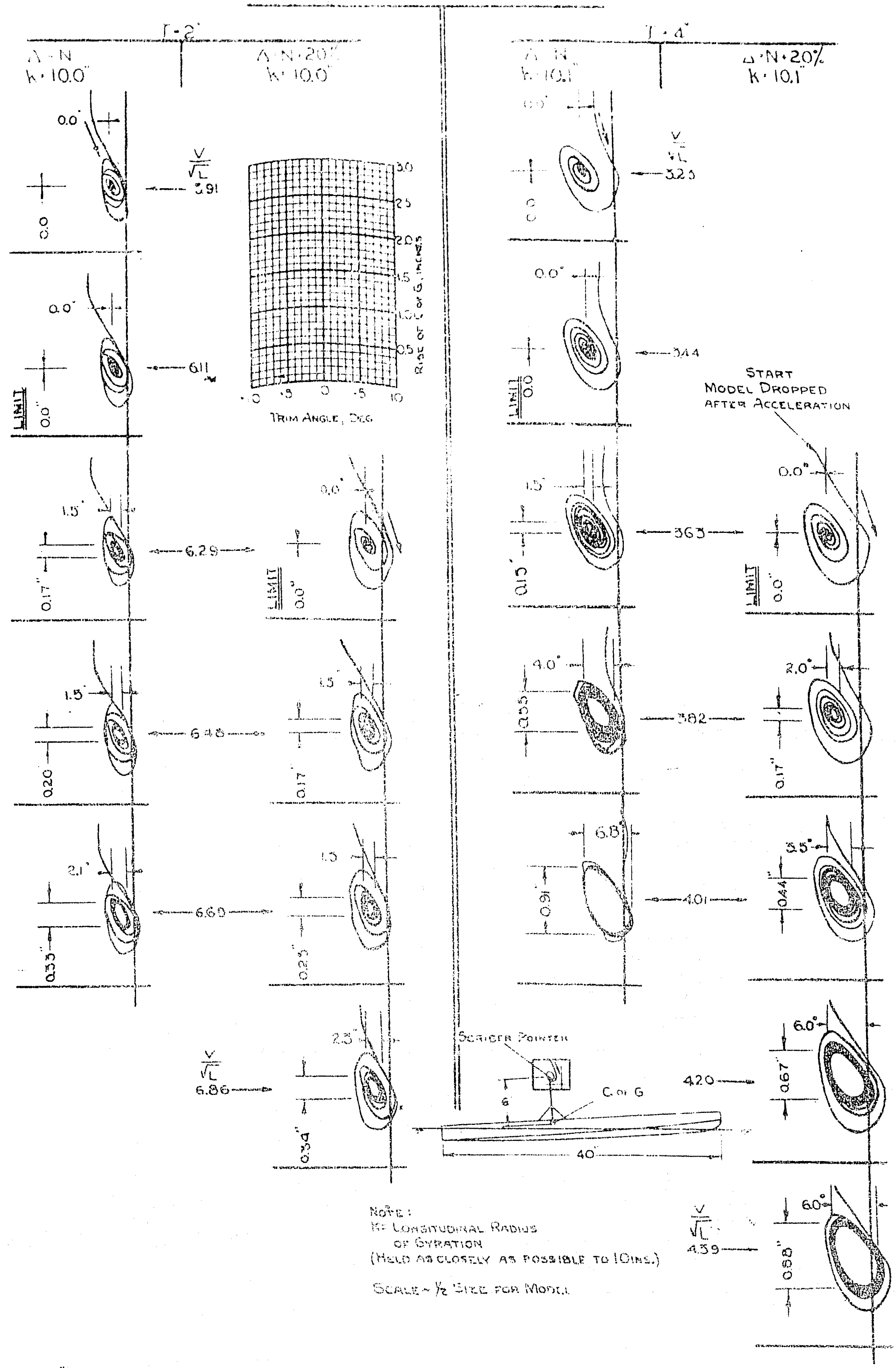
PORPOISING CHARACTERISTICS

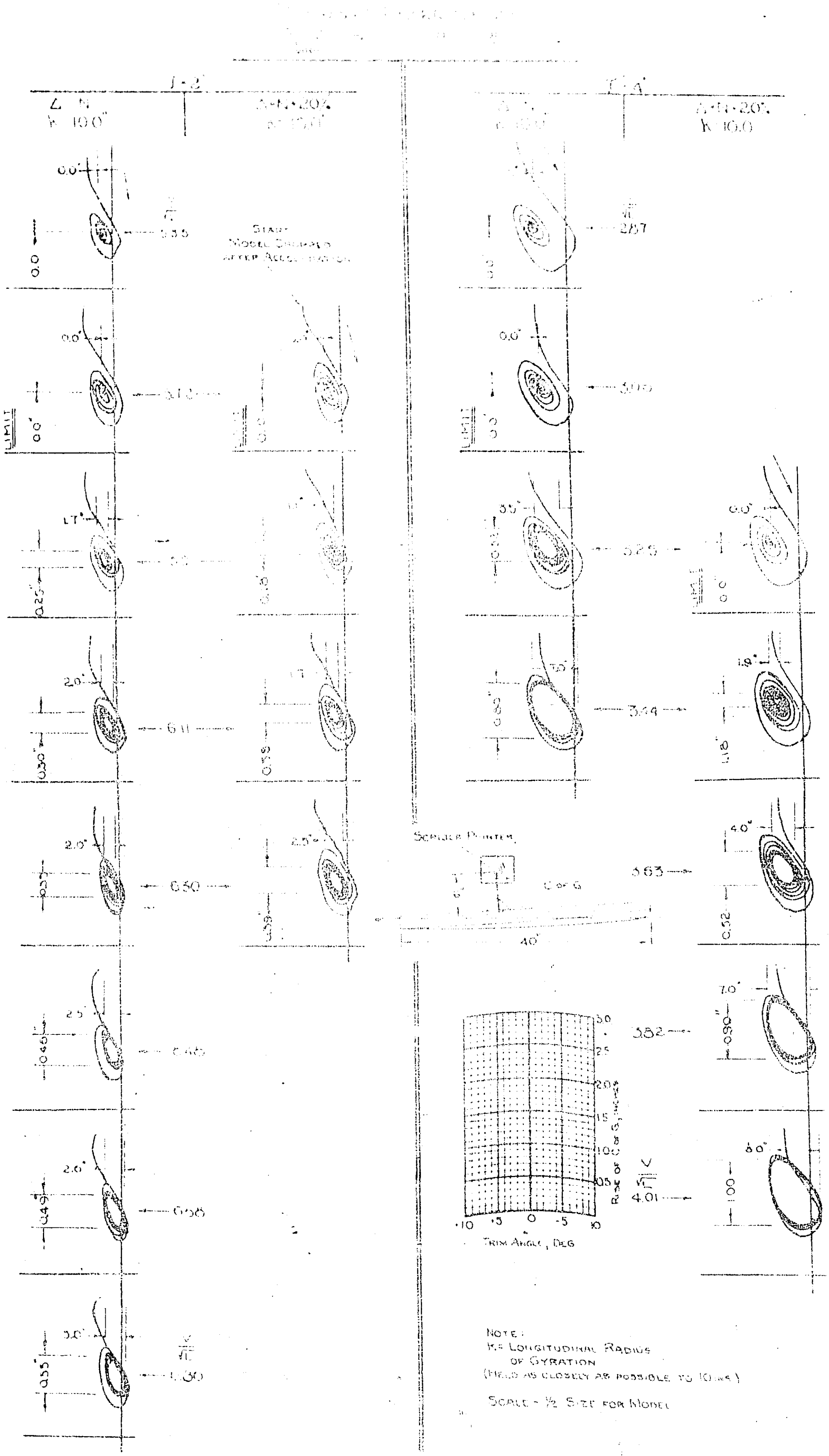
$\Delta/(L/100)^3 = 40$ $B/H = 6$



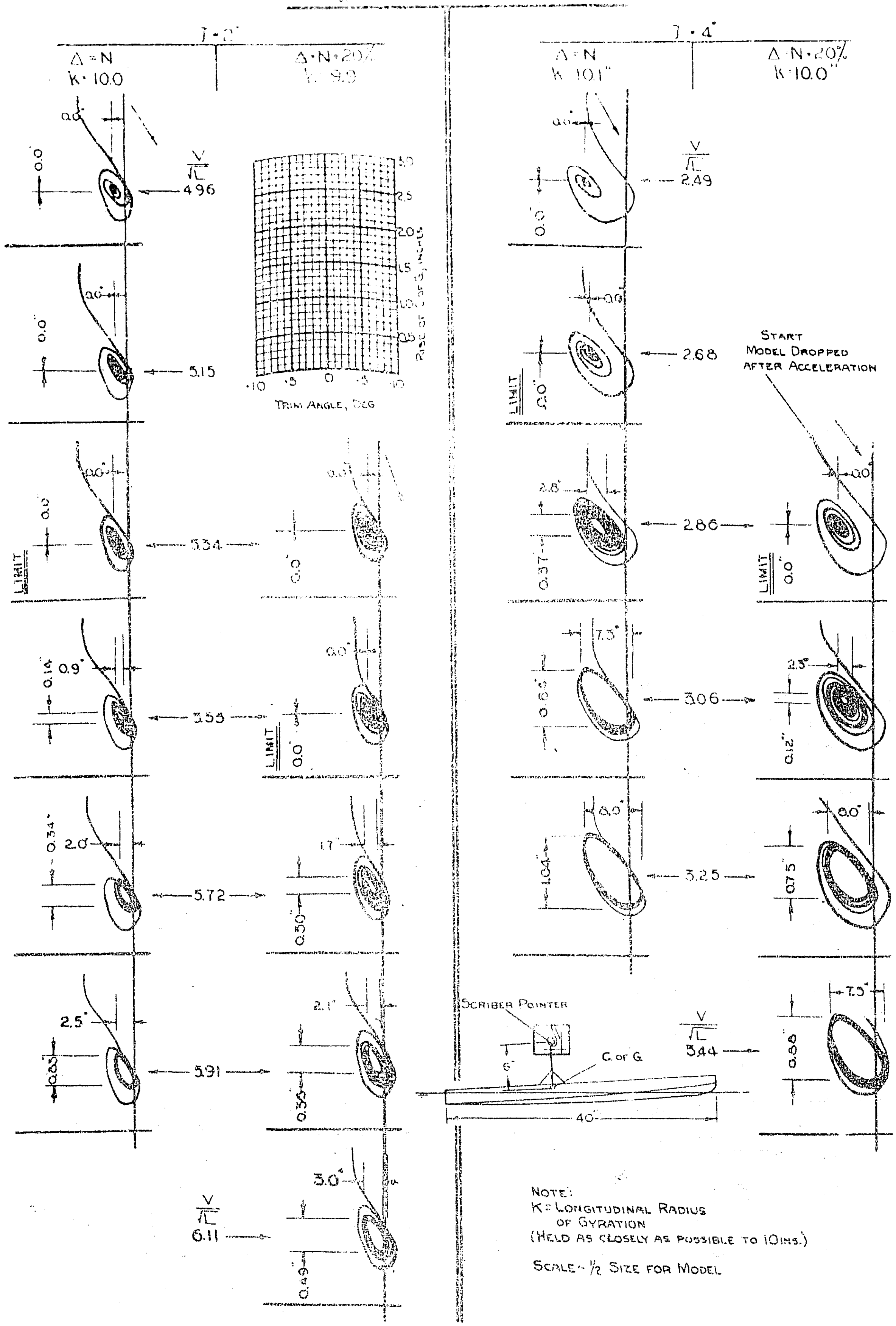


T = 4
Δ = N = 20%
K = 10.1
START
MODEL DROPPED
AFTER ACCELERATION
LIMIT
SCRIBER POINTER
C. of G.
40"

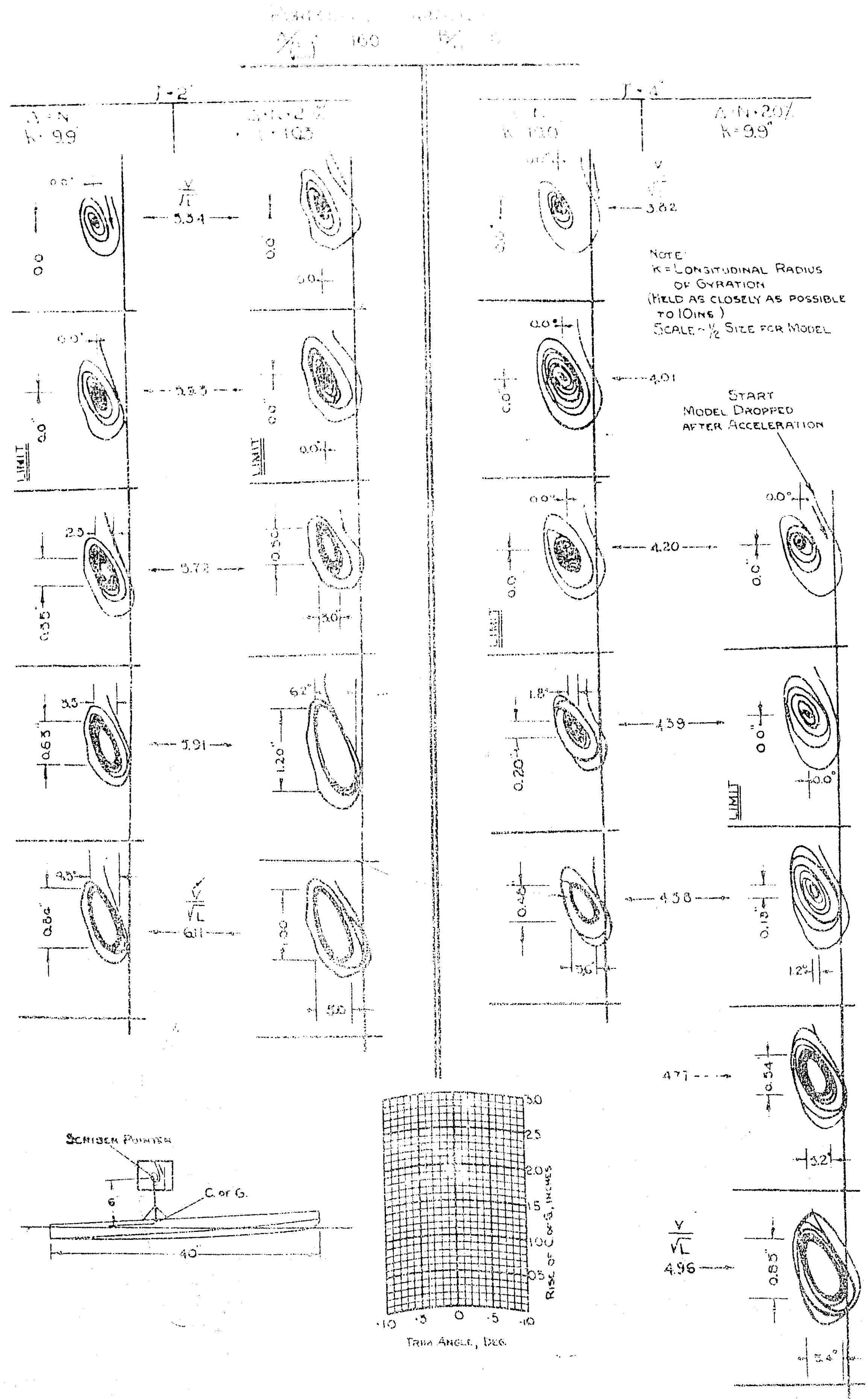

τ = 2°
τ = 4°
Δ = N
Δ = N + 20%
k = 10.0"
k = 10.1"
V/√L
3.91
6.11
6.29
6.48
6.60
6.86
3.25
3.44
3.63
3.82
4.01
4.20
4.39
LIMIT
TRIM ANGLE, DEG
RISE OF C OF G, INCHES
START
MODEL DROPPED
AFTER ACCELERATION
SCRIBER POINTER
C of G
40"
NOTE:
K = LONGITUDINAL RADIUS
OF GYRATION
(HELD AS CLOSELY AS POSSIBLE TO 10 INS.)
SCALE ~ ½ SIZE FOR MODEL



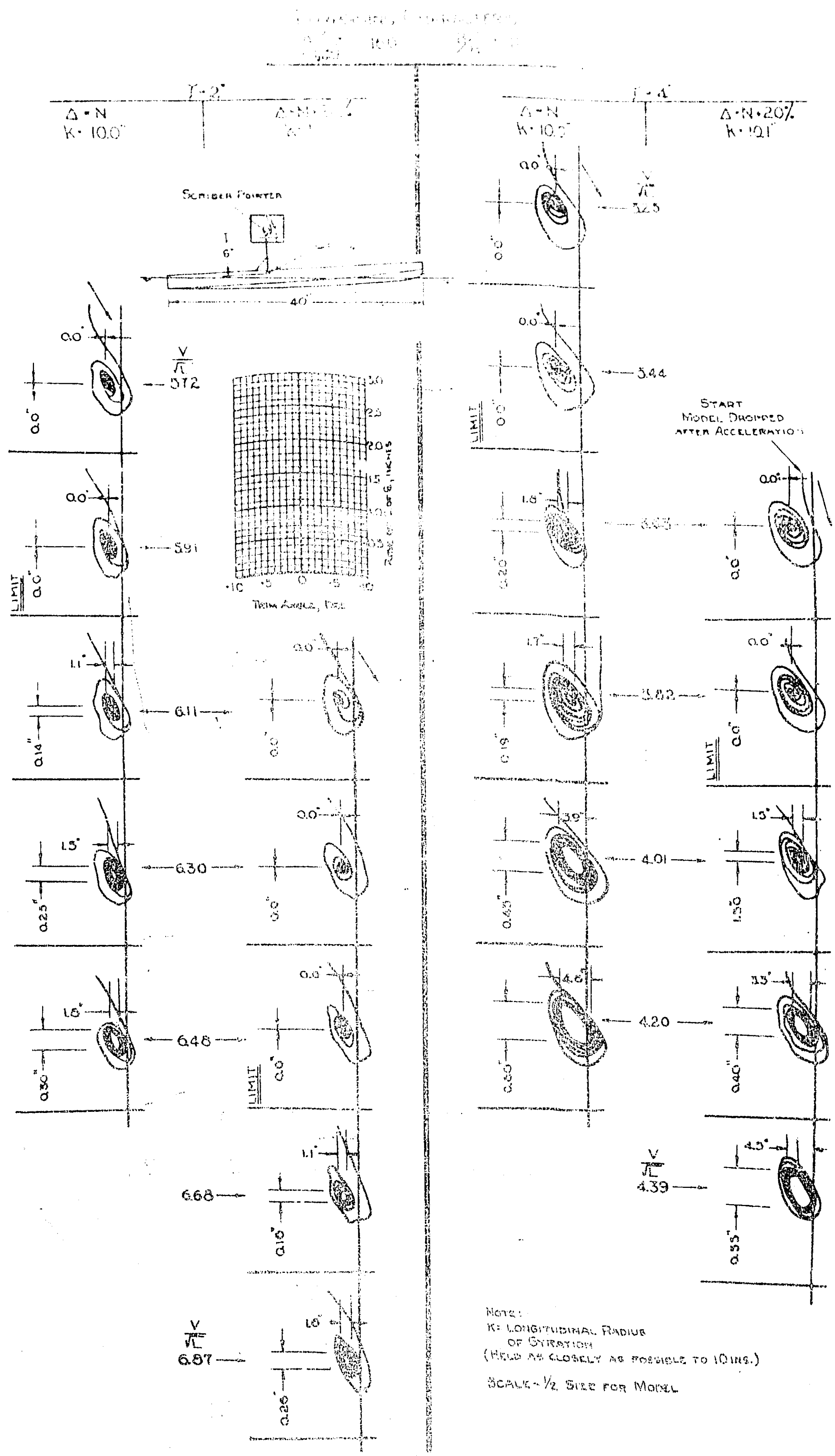
Scriber Pointer
C of G
40"
Trim Angle, Deg
Rise of C of G, Inches
Note:
K= Longitudinal Radius of Gyration
(Held as closely as possible to 10 in.)
Scale - ½ Size for Model



Δ = N
k · 10.0
Δ · N + 20%
Δ = N
k 10.1"
Δ · N + 20%
k 10.0"
V/√L
4.96
5.15
5.34
5.55
5.72
5.91
6.11
2.49
2.68
2.86
3.06
3.25
3.44
LIMIT
Trim Angle, Deg
Start
Model Dropped
After Acceleration
Scriber Pointer
C. of G.
40"
Note:
K = Longitudinal Radius
of Gyration
(Held as closely as possible to 10 ins.)
Scale – ½ Size for Model



NOTE:
K = LONGITUDINAL RADIUS OF GYRATION
(HELD AS CLOSELY AS POSSIBLE TO 10 INS.)
SCALE ~ 1/2 SIZE FOR MODEL
START
MODEL DROPPED
AFTER ACCELERATION
LIMIT
SCRIBER POINTER
C. OF G.
40"
TRIM ANGLE, DEG.
RISE OF C. OF G., INCHES


Δ = N
K = 10.0"
Δ = N
K = 10.5"
Δ = N + 20%
K = 10.1"
Scriber Pointer
6"
40"
Trim Angle, Deg.
Start
Model Dropped
after Acceleration
V/√L
5.72
5.91
6.11
6.30
6.48
6.68
6.87
5.25
5.44
3.82
4.01
4.20
4.39
LIMIT
Note:
K = Longitudinal Radius
of Gyration
(Held as closely as possible to 10 ins.)
Scale - 1/2 Size for Model

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